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ABSTRACT

Intended for use with hearing impaired students, ages 9 to 13 years, the curriculum guide is an adaptation of an existing commercially available school science program with the addition of new materials. Adaptation included reorganization of some materials; paraphrasing to aid the student with textual material; isolation of key words and phrases; the use of language cards to build scientific vocabulary; and addition of activities for students at a wide range of reading, experience, and attention levels. Introductory information covers program characteristics and goals, instructional methodology, program components and instruction on use, the program development process, a suggested teacher training workshop, and adapted and unadapted versions of a lesson plan. The bulk of the document consists of the curriculum guide organized by levels, and within levels by units of study. Provided for each unit is a unit cluster outline; list of suggested materials; readings; and information on purpose, prerequisities, advance preparation, and teaching suggestions. The curriculum covers the following units: variation, space and motion, interaction and energy, population interactions (Level 3); environments, exploring matter, patterns, exploring energy (Level 4); adaptations, forces, motion, matter and energy (Level 5); population needs, models, models of matter, energy and ecosystems (Level 6); and biology (Level 7). (DB)

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Teachers Guide for

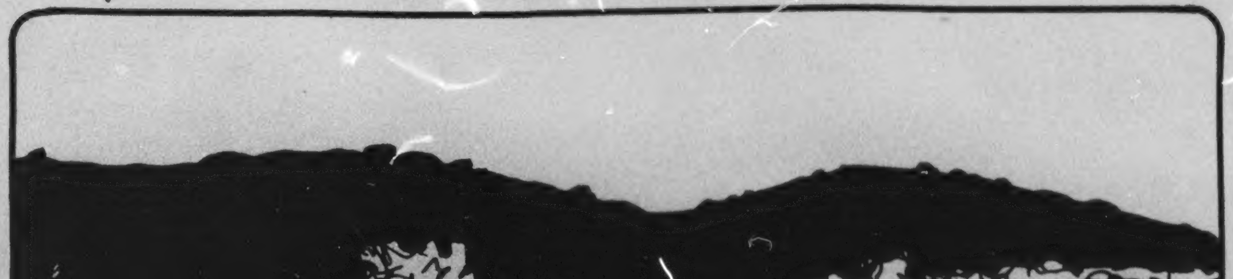
SCIENCE

Adapted

For the Hearing Impaired

Dennis W. Sunal
Cynthia Szymanski Sunal

INTRODUCTION AND LEVELS 3-7



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SFHI

SCIENCE

for

the HEARING IMPAIRED

Introduction to the Program

Edited by

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Science for the Hearing Impaired is a revision of Science (formally Modular Activities Program in Science, MAPS) and Spaceship Earth-Life Science.

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Preface

Many teachers and administrators have long been concerned with the lack of appropriate science materials and aids for teaching hearing impaired youth. This disadvantage is most critical for the middle childhood aged student in special hearing impaired classrooms or joined with their hearing peers in regular classrooms. Many students have been denied adequate access to science as a discipline because it was too difficult or because ways to present it to hearing impaired youth beyond traditional methods could not be envisioned.

To meet this concern the Science for the Hearing Impaired (SFHI) project was proposed. Its primary aim was to make available, for the first time, a complete sequenced science program for the hearing impaired which would foster the development of abilities and attitudes in the sciences in hearing impaired youths at this critical age.

This volume represents two years of planning, development, classroom testing, evaluating, and rewriting to produce a science program effective for hearing impaired middle childhood youths. To date, the success of these materials with teachers and students has been assuring. The SFHI introductory guide which describes the program materials, teaching strategies and use of program components, along with the individual program teacher's guides presents all essential information needed for maximizing learning for this special population of youth.

Many were involved directly or indirectly in this development project. This project could not have been completed without the special untiring contributions of the project writing team and the field test students, teachers, and schools. All of these made invaluable contributions which have been synthesized into the SFHI program.

Special thanks are due to the Houghton Mifflin Company who allowed our use of copyrighted program materials, freely shared program equipment and texts with the project trial schools, and provided needed support and encouragement during the development of the SFHI project.

Additional thanks for help which brought the project to fruition are offered to Ann Turli, Linda Massulo, Kathy Way, and Michaeline Davis in manuscript and audio-visual preparation.

No matter how carefully instructional materials are prepared, there are none that cannot be further improved. Therefore, we solicit your comments and suggestions as they develop from your use of the program materials. Your suggestions will be considered carefully and you will have the satisfaction of knowing that you have contributed to the improvement of science education for future students involved in Science for the Hearing Impaired.

Dennis W. Sunal
Cynthia Szymanski Sunal
Project Directors
West Virginia University
July, 1981

Introduction

The Program

This program is a middle childhood science program based upon Houghton Mifflin's K-6 Science and junior high Spaceship Earth series.[1] It is an adapted program designed especially to meet the unique needs of a hearing impaired and deaf population. These adapted Houghton Mifflin programs (Science for the Hearing Impaired) include five levels, approximately ages 9-13.

Each level, 3 through 7, of Science for the Hearing Impaired consists of an adapted teacher's guide and signed vocabulary videotapes. Though the authors have attempted to make the guides as comprehensive as possible, they are not meant to be used independently of the regular Houghton Mifflin program materials. Science for the Hearing Impaired adds additional instructional aids which extend the use of the Houghton Mifflin materials to language delayed students in special or regular classrooms. The students use the Science and Spaceship Earth textbooks, materials, and equipment extensively. The regular Houghton Mifflin teacher's guides are necessary only for occasional reference.

Goals of the Program Design

In designing Science for the Hearing Impaired the authors had specific goals in mind;

1. To produce and disseminate an adaptation of an effective and acceptable commercially-available science program, used as a regular part of the curriculum in our nation's schools, for the use with Middle Childhood hearing-impaired students.
2. To develop a science program that promotes a classroom environment which places value upon science, encourages development of skills, interests, and attitudes and makes science an important part of life and planning for future careers.
3. To develop a science program that promotes cognitive and language development.

Program Characteristics

Science for the Hearing Impaired was designed through; 1) selection and modification of existing school science programs, and 2) creation of new materials to meet the needs of hearing impaired students in our schools. This is the first program developed on a national level to address this special elementary and middle childhood population. That there is a need for such a program has been well documented.[2] In the past, because of the lack of a special science curriculum, teachers of hearing impaired students often spent hours modifying lessons to meet the special needs of these youths. Since much of this has already been done in Science for the Hearing Impaired a great deal of time is saved for the teacher. This time can now be devoted to the more important individualizing activities in teaching.

Five key types of adaptation were used to support the selection, modification, and creation of new material for hearing impaired/language delayed youth.

Reorganization

First, reorganization and field testing of results of objectives, lessons, and content within lessons took place as necessary. However, the basic integrity of the program was maintained. Within the program, changes were made to suit the needs of hearing impaired students while accomplishing the objectives as described in the original curriculum. Numerous activities were added to the existing school science programs to help reinforce concepts concretely. The order of lessons were changed where appropriate, so that the student can have concrete experiences with a concept before it is introduced. Lessons that were considered too abstract or ambiguous were omitted. All of these adaptations were guided by criteria which emphasized maximizing learning while saving the teacher's valuable time and energy.

A complete experimental edition of Science for the Hearing Impaired was nationally field tested with hearing impaired and deaf youths and evaluated by teachers of the deaf. The test population was drawn from urban, suburban, and rural settings. The teachers evaluated each lesson, classroom management and organization were monitored, and student progress was continuously measured. This final edition of Science for the Hearing Impaired is a culmination of these efforts.

Paraphrasing

Paraphrasing was a second form of adaptation used. Many hearing impaired students have a low reading vocabulary or are not familiar with either multiple meanings of words or multiple words for the same things. The complexity of phrases, sentence construction, or paragraphs also pose great problems for language delayed youth. Therefore, the teacher must use a variety of types of paraphrasing when text materials and directions are present in lessons. Suggestions for paraphrasing were included in the adapted teacher's guide. While reading and/or teacher paraphrasing of the text is a part of most lessons, textual content is also presented concretely through many hands-on activities. In this way, the material is presented in a variety of ways, student involvement is encouraged, and interest is increased.

Key Words

Key Words and Phrases were isolated for each lesson. This included scientific terms as well as words typically difficult for hearing impaired youths. These words and phrases appear on the first page of a lesson. They are boxed off on the right hand margin to ease reference for special instructional consideration by the teacher. Science for the Hearing Impaired is activity-oriented. Language interaction is constantly encouraged through teacher-student dialogue and small group work. New vocabulary is not just memorized but is used repeatedly throughout the program so that the student will begin to internalize it, generalize the terms across lessons, and eventually use it spontaneously.

For schools utilizing signing, an added feature available with Science for the Hearing Impaired is a set of videotapes in which the key vocabulary words isolated in each lesson are signed. These Signed Vocabulary and Language Videotapes are especially useful for introducing unfamiliar and technical signs to the teacher. Time consuming research or improvisation by the teacher is eliminated.

Language Cards

The use of Identification Cards and Language Cards are two instructional methods which were also key parts of the adaptation. Identification Cards are name tags of objects in the environment. Examples might be "aquarium" and "chameleon". All key objects relating to each science lesson should be labeled with an Identification Card made with a felt marker on a piece of posterboard or oaktag. The continued visual impact of the Identification Cards will reinforce vocabulary learning in the students. Language Cards are strips of stiff paper on which questions and sentences are written. These accompany the key lesson (oral and/or signed) questions and statements of the teacher. Students are thus given additional support for involvement in discussion and activities. Suggestions for Identification and Language Cards and encouragement of their use are included in the adaptation.

In addition to emphasis on visual display of language being communicated, several strategies designed to foster language development are utilized. These include the use of concrete examples incorporating multiple senses, encouragement of group interaction, and planned lesson sequence patterns.

Additional Activities

Additional activities were included in the adaptation to make it useful with students in the range of reading, experience, and attention levels.

Science for the Hearing Impaired is a planned, continuous program for the middle childhood years, ages 9 - 13. Additional acceptable but, at present, unadapted materials are available to extend the range of the program from early childhood through the first years of high school, ages 5-15. Concepts, skills, and vocabulary are introduced, developed, and reinforced throughout the program thus building a consistent pattern of meaningful learning in the student's mind and within the science program in a school. Such consistency promotes good communication among the teaching staff at various levels within the school and helps parents understand the program their child moves through from year to year. Also, Science for the Hearing Impaired is available as a complete package. Too often texts and teacher's guides may be available from one company but manipulative materials and media used for each lesson must be gathered or purchased from a number of other sources. This can cause added expense and unnecessary work on the part of the teacher and administrator. Science for the Hearing Impaired helps to solve this problem. All levels, except for 7, are fully equipped with the necessary materials, audiovisuals, and supplementary activities from a common source.

A sample lesson demonstrating these adaptation processes with a comparison of an unadapted lesson can be found in the appendix.

Program Goals

Science for the Hearing Impaired develops the following skills:

Observing -- Describing
Investigating -- Manipulating
Organizing -- Quantifying
Generalizing -- Applying

These skills are general problem-solving skills that apply equally well to classroom and non-classroom situations. In the science classroom, a fifth level student may be solving a problem in relative motion using skills which, in his or her personal life, may be used to find the quickest way to complete a paper route, the most efficient way to allocate time for homework, or the next move in a chess game. Students have many opportunities to work on all skills at each level. At levels 3 and 4 the concentration is on the first six skills. The upper levels place a greater emphasis on generalizing and applying.

The National Science Teachers Association (NSTA) has recommended a number of conceptual themes, or big ideas, in science to be used in developing a sequential science curriculum. The science content in levels 3 - 7 of this program have their roots in the NSTA recommendations. Each theme integrates the problem-solving skills with the content of the theme. The themes are:

I. There are structural patterns in all matter.
II. There is order in space and time.
III. Change and interaction are universal.
IV. Living objects change and interact.

Program levels 3 through 6 are general science oriented. Content from each theme is presented in a separate unit in each level as follows:

I. There are structural patterns in all matter.

Level 3 Unit 1: Variation
Level 4 Unit 2: Exploring Matter
Level 5 Unit 2: Forces
Level 6 Unit 3: Models of Matter

II. There is Order in Space and Time.

Level 3 Unit 2: Space and Motion
Level 4 Unit 3: Patterns
Level 5 Unit 3: Motion
Level 6 Unit 2: Models

III. Change and Interaction are Universal.

Level 3	Unit 3:	Interaction and Energy
Level 4	Unit 4:	Exploring Energy
Level 5	Unit 4:	Matter and Energy
Level 6	Unit 4:	Energy and Ecosystmes

IV. Living Objects Change and Interact

Level 3	Unit 4:	Population Interactions
Level 4	Unit 1:	Environments
Level 5	Unit 1:	Adaptations
Level 6	Unit 1:	Population Needs

Level 7 of Science for the Hearing Impaired is life science oriented. The level is divided into three units;

Looking at Life
Life Systems
Biological Systems

Each unit relates in a less structured way to the four conceptual themes through a life science content. Classification is an important focus of this level. Illustrations and an extensive overview of various life forms help students understand how and why organisms are classified.

A comparative study of animal and plant life systems underscores similarities and differences. Emphasis on the human body is strengthened by carefully chosen health topics. After the basic introduction to anatomy and physiology, students learn about the interactions of organisms, ecosystems, and where human life fits into the world environment. A more detailed description of the content of each level can be obtained by reference to the individual adapted teacher's guides.

Instructional Methodology

Science for the Hearing Impaired uses a learning sequence which attempts;

1. familiarization through exploration (Introduction),
2. purposeful teaching of lesson objectives in a concrete manner appropriate to student needs (Development) and,
3. multiple use of the ideas gained in a variety of situations (Application and Evaluation).

The three phase sequence is especially useful with hearing impaired students since these students typically find reading and learning abstract and difficult. This learning sequence provides ample opportunity for first-hand experience with new concepts and skills so that students not only read about new ideas but get involved with them. A more traditional approach used in many science programs of explaining the concept first, followed by practicing the concept, was found in the schools studied in this project to delay student learning by as much as two to four years.

The Introduction phase is an activity-oriented exploration. It gives students an opportunity to experience concretely, gather information, relate to past experience, and make discoveries by themselves. Within each cluster, or section, the first lesson(s) begin here. Sometimes whole clusters provide an exploration for ideas introduced later.

In the Development phase new skills and concepts are presented to the students. Learning is promoted by concrete explanation through a variety of appropriate experiences and is closely related to the exploration activity. Development takes place in the middle or central lessons within each cluster or section.

Enrichment lessons are also included. These lessons provide additional introduction and development of the learning sequence in different areas to facilitate transfer.

The third phase of the sequence, Application, encourages students to apply the new concept to examples not directly referred to in the Development Phase. It provides for learning through repetition and practice. In this way students can begin to extend the range of applicability of the new concept. In each cluster or section Application lessons occur at the end and may involve a number of lessons.

An Evaluation lesson is also included in each cluster. Students are expected to be able to apply concepts and skills they have just gained, rather than simply memorize facts learned in previous lessons. In this way, meaningful understanding rather than rote "learning" is being encouraged and evaluated.

The three phase learning sequence is efficient only if students are working at an appropriate level matched to their stage of development. Typically students are grouped for instruction according to reading, achievement, or IQ scores. With the hearing impaired this is particularly inappropriate since such measures are language based. The authors suggest pretesting students at the beginning of the year using an appropriate test of problem-solving and thinking ability. This procedure minimizes language as a prerequisite in grouping and matching students to program level. By noting similarity in scores, appropriate placement within similar groups of potential performance at a specific level of the program is possible. During the field testing of this program, an "Inventory of Piaget's Developmental Tasks" - a paper and pencil inventory - was used and proved to be effective. For furhter details on testing and grouping contact the program authors.

Program Components and Instruction on Use

Total program components include materials published through Houghton Mifflin as well as the Science for the Hearing Impaired (SFHI) adapted program materials. The Houghton Mifflin materials include the student texts for the Science series, Level 3 to Level 6, and Spaceship Earth - Life Science, for Level 7, and their corresponding Teacher's Guides. To supplement the Science text, Houghton Mifflin also produces audiovisual materials and equipment packages. A Laboratory Record Book and Duplicating Masters for Progress Tests accompany Spaceship Earth - Life Science.

The Houghton Mifflin materials and the SFHI adapted materials are to be used jointly in establishing an appropriate science program for hearing impaired students.

Teacher's Guides, Levels 3 to 6

The Science teacher's guide and the SFHI adapted teacher's guide are to be used together. The Science teacher's guide is used for general information about the series while the SFHI teacher's guide is used for information on specific lessons. When using the Science teacher's guide, the teacher should focus attention on the scope and sequence of the text as a whole, how a particular level is taught, unit overviews, concept/progress charts, the glossary, the cluster master materials list, and student worksheets. This information is only included in the Science guide and is not repeated in the adapted guide.

The SFHI teacher's guide gives information about lesson clusters and specific lessons (see Appendix A for a sample lesson format). It has been designed to be a complete package so that lesson planning within clusters can usually be done with the SFHI teacher's guide and Science student text alone. Preplanning for the cluster as a whole will require the Science teacher's guide in addition. Lesson cluster outlines describe the Science teacher's guide reference page, teaching strategy, lesson title, and teaching time. Also, notes on lessons, additional materials required, and filmstrip information are provided.

Complete descriptions of the individual lessons in the cluster follow the cluster outline. First, the teaching strategy for the lesson is listed along with the title and location of the lesson in the Science teacher's guide and student textbook. Second, the lesson itself is presented. It contains; 1) the Lesson Purpose, 2) Prerequisites, where necessary, and 3) Advanced Preparation which includes Background Information from the Science teacher's guide, and a listing of all materials necessary for the lesson.

Third, a box to the right of Advance Preparation indicates Language Cards/ Key Signs and Identification Cards. The Language Cards/Key Signs section lists vocabulary and phrases that students should learn during the lesson. The teacher is encouraged to write each word on a card and to display these cards during the lesson. Signs for each of the vocabulary words listed in the Language Cards/Key Signs section are demonstrated in the Signed Videotapes. The Identification Cards section includes vocabulary that is to be written on cards and posted with the materials used in the lesson. The fourth section, Teaching Suggestions, includes the instructional steps to be used in a particular lesson. Desired Learning Outcome, the final section, describes what the student should be able to do at the completion of the lesson.

Each lesson cluster and lesson is organized in the same way for each of the levels, 3 to 6. However, materials for Spaceship Earth are somewhat differently organized.

Teacher's Guide, Level 7

As with the Science series, the Houghton Mifflin teacher's edition of Spaceship Earth - Life Science and the SFHI adapted teacher's guide level 7, are used jointly. However, because there is much less overlap between these two guides, the teacher must use both guides to establish a complete program.

The Houghton Mifflin teacher's edition of Spaceship Earth begins with information on materials, suppliers of materials, and possible films and filmstrips to be used with each chapter. Student objectives are stated for each chapter, and explained by identifying how the students will show they have learned each objective. This information is not included in the SFHI Level 7 teacher's guide. The teacher's edition also has section notes. These notes include information about the chapter's section, background information, demonstrations, activities from the text, optional activities, discussion information, enrichment activities, answers to checkpoints and skullduggery questions, current ideas, and a bibliography for both students and teachers. All of this information is important but is not duplicated in the SFHI teacher's guide. Accompanying the Spaceship Earth teacher's edition are a student text, student Laboratory Record Book, and Duplicating Masters for Progress Tests. The Laboratory Record Books contain sheets to be filled out as the students complete experiments which are listed in the text. The Progress Tests include chapter tests and two cumulative tests.

The organization of the SFHI Level 7 teacher's guide for Spaceship Earth - Life Science is similar to the SFHI teacher's guides for the Science series. However, because of the organization of this book a few of the components are different. Lessons for Spaceship Earth are grouped by chapters. Each chapter in the text is divided into numbered sections. Lessons in the SFHI teacher's guide are grouped according to these numbered sections. Listed first is the section outline which indicates the corresponding page numbers in the Spaceship Earth teacher's guide, section numbers, lesson titles, and suggested teaching time.

Descriptions of the lessons follow the section outline. The chapter, section, lesson title, and location in the student text and Houghton Mifflin teacher's guide are listed at the beginning of the lesson. The objectives for the lesson are noted when they differ from those listed at the beginning of each chapter in the Spaceship Earth teacher's edition. Prerequisites for the lesson are listed only when necessary. Background information is noted when different from the Houghton Mifflin teacher's guide. The advance Preparation section includes materials for the lesson which are in addition to those listed in the Spaceship Earth teacher's edition. Therefore, the teacher must refer to both guides when locating materials necessary for the lesson.

Lessons for SFHI Level 7 also include the Language Cards/Key Signs and Identification Cards sections. These sections are used as they are in Levels 3 to 6. Signs for the vocabulary from the Language Cards/Key Signs are located on the Signed Vocabulary and Language Videotapes. Teaching Suggestions are listed as they are in Science, Levels 3 to 6. These suggestions include the necessary instructional steps to complete the lesson. The Spaceship Earth Teacher's Guide does not list a desired learning outcome for each section. Therefore, this section has not been included in the SFHI teacher's guide. Each chapter and lesson are organized in the same manner for all of Level 7.

Texts, Science and Spaceship Earth

The textbooks should be used by the students for each lesson, except where noted in the SFHI adapted teacher's guides. Specific uses of the textbooks will vary from class to class. The pictures and graphics can be easily used.

There are several possible ways in which the students could interact with the written language component of the science program textbooks. If the language/reading level of the students is such that students can read and comprehend the materials, with or without teacher help, then they should be asked to read the material. However, if the text is too difficult or inappropriate for the student, the teacher can; 1) rewrite the text, keeping in mind the vocabulary listed, 2) paraphrase the information, or 3) read the text to the class while modifying the language and explaining concepts as necessary. When one of these procedures is suggested for lesson preparation the others should be considered as suitable substitutes. Flexible use of the language/reading component of the textbooks will enable students to receive information on their cognitive level, which may not be commensurate with their language/reading level.

Signed Vocabulary and Language Videotapes and Index

Videotapes have been produced which accompany Science for the Hearing Impaired Levels 3-7. These videotapes include signs, in American Sign Language and Manually Coded English, for each vocabulary word listed in the Language Cards/Key Signs and Identification Card sections.

The Signed Vocabulary and Language Videotapes should be used by the teacher, reviewing one lesson cluster or section at a time. This will take 2-5 minutes. By reviewing a lesson cluster or section before instruction occurs, the teacher will be assured of familiarity with the appropriate signs for the identified vocabulary. These tapes can also be used by students to learn signs for new vocabulary after the vocabulary itself has been experienced and/or used in discussion in the class, or for review of vocabulary.

A Signed Vocabulary and Language Index to the tapes is located in the Appendix of the SFHI teacher's guide for each level. This index lists each cluster or section, the specific location of that lesson in the program, and the vocabulary words signed for that lesson. Within each cluster or section of lessons the same vocabulary important in more than one lesson is not repeated in the Index or Videotape. Repetition of important vocabulary does occur between clusters or sections.

These videotapes are available for purchase and/or copying from the authors by writing the Department of Curriculum and Instruction, College of Human Resources and Education, West Virginia University, Morgantown, WV 26506.

Audiovisual Materials

Audiovisual materials are produced by Houghton Mifflin for the Science series but not for Spaceship Earth.[3] One set of filmstrips accompanies most of the units in each level. The filmstrip set contains three captioned color filmstrips, sound cassettes, duplicating masters for pupil response sheets, and a teacher's guide. The cassette accompanying a filmstrip has two sides. One side has basic information while the other side has enrichment information along with the basic information. Use of these filmstrips is noted in the cluster outline.

Suggested planning for use of the filmstrips involves the teacher preparing for their use by; 1) reading the teacher's guide and response sheets, 2) listening to the cassette for a possible presentation model, and 3) viewing the filmstrip. Use of the filmstrip in the classroom has been effective through use of the captions and discussion alone. Additional strategies would include the teacher paraphrasing cassette materials from notes made earlier.

Equipment and Materials

Houghton Mifflin produces equipment packages for the Science series but not for Spaceship Earth. One equipment package accompanies each level. Each package contains most of the materials necessary for that level's activities. Common and easily obtained materials, as well as living plants and organisms must be obtained by the teacher from local sources. Care should be taken to plan for materials to be secured at an early date. Materials information can be found in the Houghton Mifflin and SFHI program teacher's guides.

Program Development Process

Regardless of the type or source of the school science curriculum, teachers for the hearing impaired are consistently faced with decisions regarding the selection, development, and modification of effective science materials. In the past, at least six problem areas were associated with the use of traditional science programs with hearing impaired youth. They were;

1. Emphasis of facts and memorization vs. skills and science processes.
2. Activity with known results vs. discovery and unknown results.
3. Amount of reading material vs. active participation in meaningful activities.
4. Appropriate material (adapted for the hearing impaired student).
5. Difficult terminology.
6. Advanced concept level.

This project attempted to address these problem areas in developing an effective science program and establishing a model for curriculum development for hearing impaired youths.

The project was originally funded in May, 1980 by the National Science Foundation through the Physically Handicapped in Science Program. The de-developmental process used available literature and school science programs in addition to the experiences of a number of curriculum developers, teachers of the hearing impaired and science teachers. The first step involved an analysis of existing science programs used and available to schools with hearing impaired students in the United States. The results and analysis instrument, Curriculum Analysis Guidelines (Sunal and Burch, 1978), led to the criteria used in the final selection process. This process concluded that two programs published by the Houghton Mifflin Company provided the most effective base program and greatest potential for adaptation for hearing impaired/language delayed youth, Science and Spaceship Earth.

The development continued with writing, national field testing and rewriting of program materials and sequence. The project time line for development of Science for the Hearing Impaired is shown below.

Development

May, 1980	Complete analysis of science programs Planning conference
Summer, 1980	Writing and adapting materials for experimental SFHI program Regional pretesting of sample program components
Academic Year 1980-1981	National field testing of experimental SFHI program
Spring, 1981	Analysis of field test results and program revision
Summer, 1981	Preparation of final edition of the SFHI program

Dissemination

April, 1981	Adaptation model presented and SFHI program workshop given at National Science Teachers conferences
Summer, 1981	Distribution of sample and full SFHI program sets, levels 3-7
Academic Year 1981-1982	Notification, description, and workshops involving SFHI program given in journals, at conferences, and in school systems Continued distribution of sample and full SFHI program sets

Teaching for Hearing Impaired: A Workshop

For effective use of the Science for the Hearing Impaired program, teachers should be familiar and have extended experience with the Houghton Mifflin science materials and the SFHI program components. Just reading about the adaptation, as in this program introduction, is inadequate. Familiarization should include activities such as preparing sample lesson materials, engaging in laboratory activities, discussing the rationale and methods of involvement of students in learning, and comparing ideas with professional colleagues.

To provide for effective implementation of Science for the Hearing Impaired in classrooms, a workshop provided by appropriate personnel from a school system, State Department of Education, a university, or the Science for the Hearing Impaired staff is suggested. A workshop schedule might include the following items:

SFHI Workshop Outline

I. Summary of Project
   A. Goals
   B. Procedure

- II. Summary of Curriculum
  - A. Goals
  - B. Activities
- III. Development of Reasoning in Students
  - A. How Students Think
  - B. Concrete and Formal Reasoning Patterns
  - C. Self Regulation and the Learning Cycle
  - D. Textbooks, Lab activities and Tests

- IV. Science Curricula and Lessons Traditionally Used in Schools
- V. Pretesting and Posttesting
  - A. Science Interest Survey
  - B. Student's Developmental Level Survey
- VI. Introduction to the SFHI Curriculum
  - A. Adaptation Components
    - 1. Overview of Format for Clusters and Lessons
    - 2. Specific Components Emphasized
    - 3. Review of Modifications in Various Grade Levels
  - B. Demonstration of Adapted Lesson (live and on videotape)
  - C. Language Adaptations
- VII. In Depth Review of Adapted Curriculum Components
  - A. Equipment
  - B. Audio-Visual Materials
  - C. Evaluation
  - D. Signed Vocabulary and Language Videotapes and Index
  - E. SFHI Teacher's Guide
- VIII. Comparing the Adapted Program to Unadapted Materials.
- IX. Additional Curriculum Modification to Local Conditions
  - A. Goal Areas and Data Records
  - B. Building a Student Evaluation Profile
- X. Individual Planning
  - A. Distribution of Related Materials
  - B. Individual Review and Preparation for First Months Activities in Grades Taught
  - C. Individual Review and Listing of Needs for Completion of Units 1-4 for Levels to be Taught
- XI. Feedback on Areas Covered in Workshop and on Adapted Curriculum

Information on arrangement for having a workshop presented at your school by the Science for the Hearing Impaired staff may be obtained from:

Dennis W. Sunal or Cynthia S. Sunal, editors
Science for the Hearing Impaired
Department of Curriculum and Instruction
West Virginia University
604 Allen Hall
Morgantown, W:V. 26506

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1. Houghton Mifflin Company, One Beacon St., Boston, MA. 02107.
2. Burch, D. and Sunal, D. "Science Curricula for the Hearing Impaired: Present State of the Art" in H. Hofman ed. Science Education for Handicapped Students, Washington, D.C.: National Science Teachers Association, 1978.

   Tomlison-Keasey, C. and Kelly R. "The Development of Thought Processes in Deaf Children". American Annals of the Deaf, 1974, 119, 693-700.
3. Additional captioned Audio-visual materials may be obtained by writing; National Geographic Society, P.O. Box 1269, Washington, D.C. 20017 and Captioned Films for the Deaf, Distribution Center, 5034, Wisconsin Ave. NW, Washington, D.C. 20016.

APPENDIX A: ADAPTED SFHI LESSON, LEVEL 5

INTRODUCTION: Lesson Cluster 1B-1 Systems
Page T-56/S-25 On The Inside (20-35 min.)

PURPOSE: Introduce the concept that organisms may have several inside systems with different functions that help it stay alive.

ADVANCE PREPARATION: Materials - One of the following for each child:

Additional Materials

- ditto of the human body showing the following inside structures: stomach, heart, lungs, leg bones, brain, intestines. This ditto can be made by copying the diagram provided with this lesson.
- large sheet of paper (5' x 2'). Blank newsprint or wrapping paper would be ideal.
- 1 set of cut out models of inside structures. Models are provided with this lesson.
- scissors
- glue or paste
- several magic markers, crayons, pencils
- Picture showing the internal anatomy of people and other animals.

*- preserved heart, lungs, and any other internal organs that you can get from a slaughter house or other source.

*This material is optional.

Language Cards/Key Signs
inside structure
system
skeleton
stomach
lungs
heart
interact
leg bone
brain
intestines

Identification Cards
(labels for preserved organs if used)

TEACHING SUGGESTIONS:

1. Begin the lesson by asking the students to name outside structures of organisms that they have studied. Refer to pictures and examples used in previous cluster. Responses may include any observable structures, such as skin, fur, eyes, legs, leaves, roots, and mouth parts. Explain to the students that in this part they will be learning about inside structures.

2. Introduce the term inside structures with the language card and ask the students to what inside structures may refer. Accept all opinions.

3. Show the class pictures of the inside structures of humans and other animals. Point out the heart, lungs, stomach and intestines.

4. Have students read the introduction to the lesson on page 25 or teacher may paraphrase. Use the pictures already shown to reinforce the information.

5. If possible show the students samples of preserved inside structures. Label each with an identification card and display in the room for some period of time.

additional activities

additional activity

6. Distribute dittos of the human body and have students label the inside structures.

7. Distribute large sheets of paper and divide students into pairs. While one child lies on the paper the other should trace his or her outline. When complete they may change roles. When outlines are complete students should cut them out.

8. Give each child a set of internal structures that have been cut out. If preferred the students may cut out the structures.

9. Have the students label each structure and paste them in the appropriate location on their own body outline. The finished products can be displayed around the room or in one area labeled Inside Structures.

10. Explain to the students that these structures work together or interact, and when they do so they are called a system. Introduce the terms interact and system with the language cards.

11. Have students read the remainder of page 25 or teacher may paraphrase.

12. Students should answer questions either in writing or through class discussion.

13. Discuss the lesson with the students when they have completed their work.

DESIRED LEARNING OUTCOME: Ability to name inside structures that interact in a system.

****

DEVELOPMENT: Lesson Cluster 1B-1a Systems
Page T-57/S-26 A Chicken Skeleton (40-50 min.)

PURPOSE: Develop the concept of inside structural systems by introducing a skeletal system.

ADVANCE PREPARATION: Materials
- 2 pieces wire (#18 to #24) 20 cm (8 in.) in length
- 2 chicken or turkey skeletons - see Advance Preparation page T-57
- paper towels
- pictures or models of human and other animal skeletons. Pictures on page 27 may be used.

Language Cards/Key Signs
skeleton
skeletal system
bones
joint

Identification Cards
label for chicken or turkey (skeleton put on display)
labels for neck, legs, wings and ribs

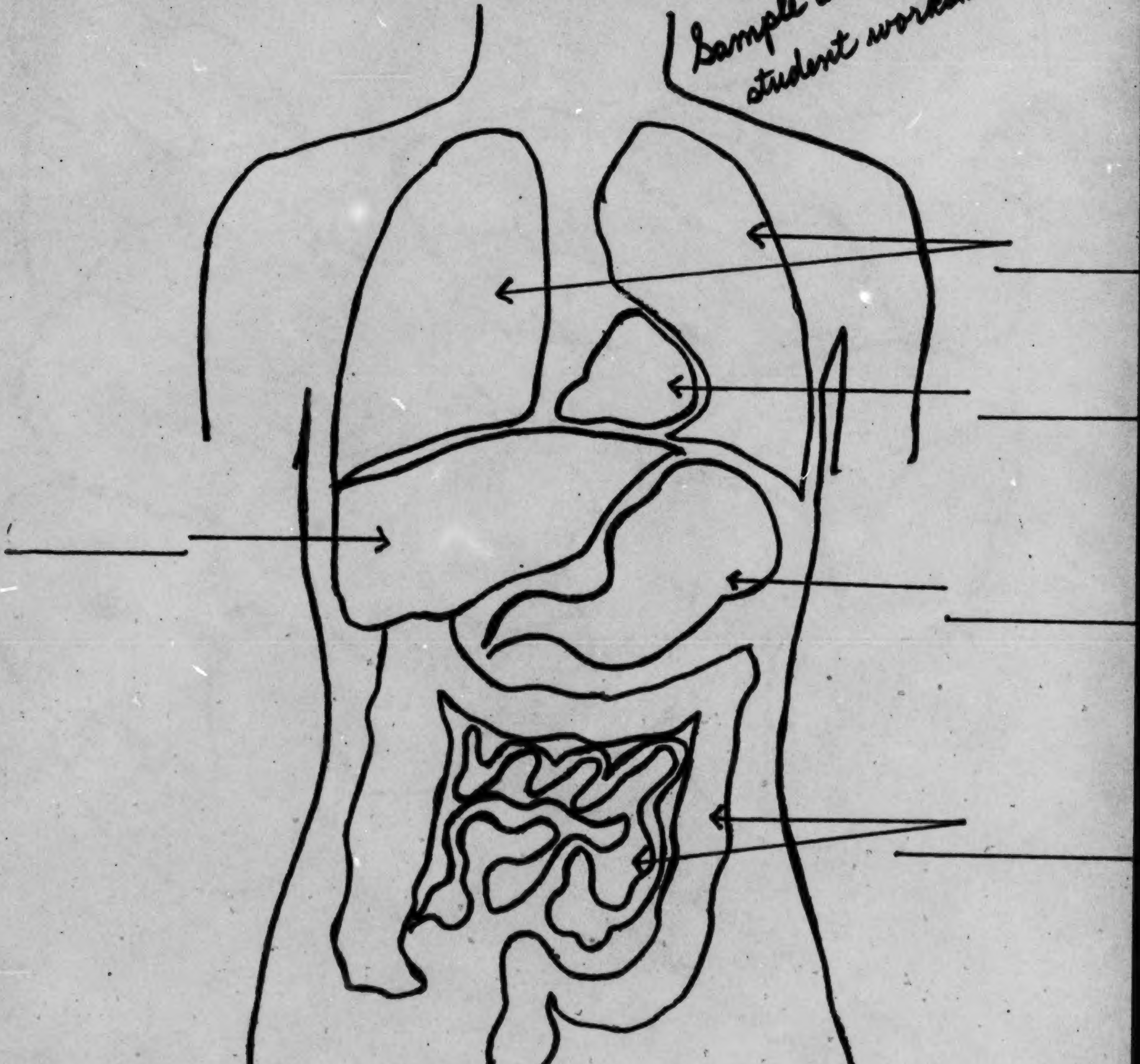
TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to turn to page 26 and view the picture. Explain that it is the skeleton or the bones of an animal. Use the language card to introduce these terms. Ask the students if they can infer from the pictured skeleton the animal to which the skeleton belongs (fowl). Encourage the students to explain why they think it's a particular skeleton.

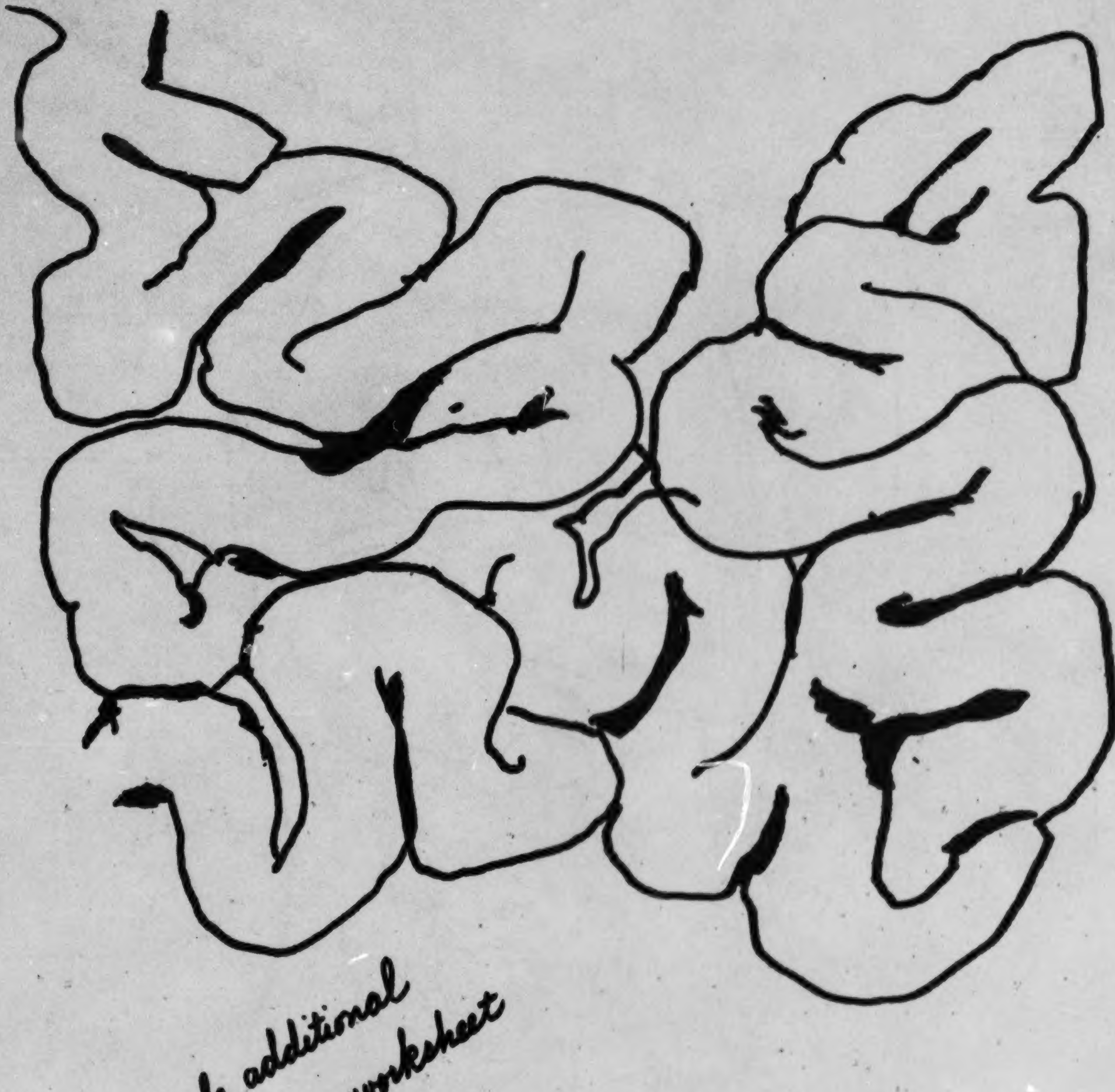
2. Have students read introductory paragraph. Teacher may paraphrase.

INTERNAL STRUCTURES OF THE BODY

Sample additional student worksheets



SMALL INTESTINES



Sample additional student worksheet

Sample Vocabulary
Index for lesson on
Level 5

SFHI

SIGNED VOCABULARY AND LANGUAGE INDEX
FOR
SCIENCE FOR THE HEARING IMPAIRED

Instructions for use of this index with the accompanying signed videotapes are found in the Introduction to the Program. This index should be used as a script when viewing the signed videotapes for the specific SFHI cluster or section of interest.

Each part of the videotape is preceded by an indication of the specific location (level, unit, part, Cluster and Lesson) of the item presented. Each item within a lesson is first presented in American Sign Language (ASL) followed by a Manually Coded English (MCE/SEE) presentation of the same item. When a lesson list is completed the title of the next lesson is given, followed by a presentation of each new lesson item in ASL and MCE.

Teachers should view the videotape in planning for each new cluster (2-5 minutes per cluster). It is also suggested that teachers view and practice the signs presented with their classes following lesson experiences or as a review. The videotape can be used as a visual dictionary when the children have forgotten the sign.

The Signed Vocabulary and Language Videotapes are available for purchase and/or copying by writing

Dennis W. Sunal or
Cynthia Szymanski Sunal
Science for the Hearing Impaired
Department of Curriculum and Instruction
West Virginia University
Morgantown, WV 26506.

Lesson	Title and Key Signs
Cluster 1B-1	Systems
1	On the Inside inside structures system skeleton stomach lungs heart interact leg bone brain intestines
2	A Chicken Skeleton skeletal system bones joint
[illegible]	Respiratory Systems respiratory system oxygen breathe gills lungs air holes air tube
4	Digestive System digestion digestive system food tube intestines anus crop gizzard stomach cud
5	A Muscular System muscular system muscles relax contracts biceps
6	Systems Interact in the Hands thumb
7	Systems Have Parts

Lesson	Title and Key Signs
Cluster 1B-2	Cells
1	What are Cells? & Looking at Cells a cell a microscope a nucleus a slide a plant cell an animal cell a microscope some plant cells some animal cells
2	Cell Structures cell structures a cell membrane a cell wall
3	Cells in Your Body human muscle cells human skin cells red blood cells white boood cells human blood cells
4	One-Celled Organisms pond water one-celled
5	Properties of Cells
Cluster 1C-1	Animal Behavior
1	What is Behavior? behavior
2	Eye Behavior eye behavior pupil
3	Earthworm Behaviors earthworm adaptation
4	Behaviors Have Functions deer spider monkeys geese racoon

■ **Introduction (1)**

Suggested Teaching Time: 15–25 minutes

1. Answers may include stomach, heart, lungs, brain, muscles, bones, veins, liver, intestines, kidneys, bladder, and others.

1.

2. Answers may include stomach and intestines—digest food; heart and veins—pump and circulate blood; muscles—move; lungs—breathe; brain—direct; kidneys and bladder—store and get rid of wastes; bones—support; liver—help digestion; and others.

Systems

On the Inside

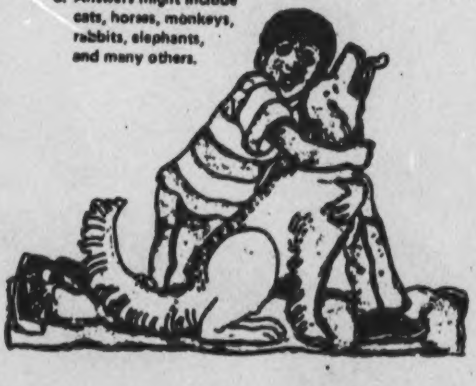
Organisms have many structures inside their bodies. The stomach, heart, and leg bones are some inside structures. People and some other animals have these structures. People have many other inside structures too.

Inside structures often interact. Interacting structures make up a system. An organism may have several inside systems with different functions. Each system does something that helps the organism stay alive.

Your stomach is part of a system that helps your body use food. Your heart is a part of another system. This system moves materials through your body. Your leg bones are part of a system called the skeleton. One function of this system is to help your body move.

1. Look at the organisms shown. Name some inside structures that they both have.
2. What might be functions of the structures you named?
3. What animals besides people and dogs might have the structures you named?

3. Answers might include cats, horses, monkeys, rabbits, elephants, and many others.



PURPOSE

To introduce the concept that organisms may have several inside systems with different functions that help the organisms stay alive.

TEACHING SUGGESTIONS

1. Begin the lesson by asking the students to name outside structures of organisms that they have studied. Responses may include any observable structures, such as skin, fur, eyes, legs, leaves, roots, and mouth parts. Explain to the students that in this part they will be learning about *inside* structures.
2. Ask the students to what *inside structures* may refer. Accept all opinions.
3. Have the students read the introduction to the lesson to find out about some inside structures.
4. Write the terms *interact* and *system* on the chalkboard. Make sure that the students can correctly pronounce the terms. Students who have done other levels of this program will probably remember that objects (or structures) interact when they work together and that the interacting objects (or structures) make up a system.
5. Have the students read the remainder of page 25 and answer the questions.
6. Let the students share their responses as they work.
7. Move around the room providing help as needed.
8. Discuss the lesson with the students when they have completed their work.

DESIRED LEARNING OUTCOME

The students should be able to name inside structures that interact in a system.

Materials: None

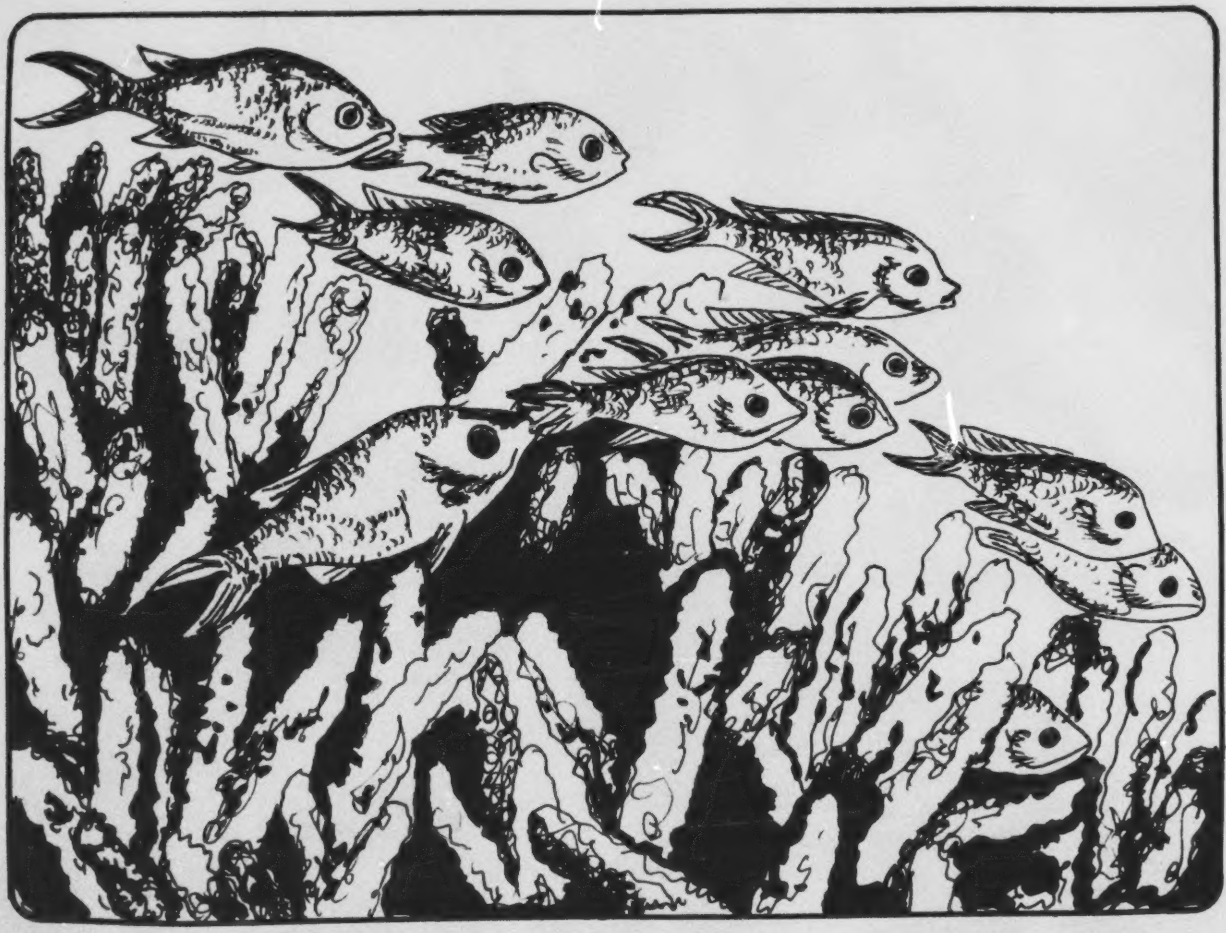
Teachers Guide for Level 3

SCIENCE

Adapted

For the Hearing Impaired

Dennis W. Sunal
Cynthia Szymanski Sunal



SFHI

SCIENCE for the HEARING IMPAIRED

Level 3

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Introduction

Many teachers and administrators have long been concerned with the lack of appropriate science materials and aids for teaching hearing impaired youth. This disadvantage is most critical for the middle childhood aged student in special hearing impaired classrooms or joined with their hearing peers in regular classrooms. Many students have been denied adequate access to science as a discipline because it was too difficult or because ways to present it to hearing impaired youth beyond traditional methods could not be envisioned.

To meet this concern the Science for the Hearing Impaired (SFHI) project was proposed. Its primary aim was to make available, for the first time, a complete sequenced science program for the hearing impaired which would foster the development of abilities and attitudes in the sciences in hearing impaired youths at this critical age.

This volume represents two years of planning, development, classroom testing, evaluating, and rewriting to produce a science program effective for hearing impaired middle childhood youths. To date, the success of these materials with teachers and students has been assuring. The SFHI introductory guide which describes the program materials, teaching strategies and use of program components, along with the individual program teacher's guides presents all essential information needed for maximizing learning for this special population of youth.

Level 3 Unit 1 Variation

Part A Variation in Objects, Lesson Cluster 1A-1

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Number	Teaching Time Suggested
T-24	Introduction	The World of Objects	30-40 min.
T-26	Development	Samples	30-40 min.
T-28,29	Development	Estimating/How Many Marbles?	30-40 min.
T-30	Application	Estimating Sizes	20-30 min.
T-31	Evaluation	Samples and Estimates	20-25 min.

B. MATERIALS: See list on page T-21.

FILMSTRIP INFORMATION: Filmstrip Set VI, Variation, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1A-1 Sampling and Estimating
Page T-24/S-3 The World of Objects (30-40 min.)

PURPOSE: To increase awareness of the great number and variety of objects that make up the environment.

PREREQUISITES: Understanding of the concepts same and different.

ADVANCE PREPARATION: Materials -variety of objects around the classroom

Language Cards/Key Signs
samples / sampling
estimating
objects
contents
variation
any lump of matter
alike
different
property

TEACHING SUGGESTIONS:

1. Distribute the books and provide time for the children to browse through them.

2. Introduce the book by having the children turn to the Contents on text pages iv and v. Point out that the book is divided into four units, and have the children find the names of the units in the Contents. Point out also that each unit is divided into parts, and that the parts are divided into lesson clusters. Use appropriate Language Cards to facilitate communication.

3. Tell the children that their books have a glossary. Use the Language Card to facilitate communication. Have them find these pages.

4. Introduce the first unit in the book. Do not define the term variation at this time. It is defined for the children later in the unit.

5. Have the children name common objects, large and small, that they observe in the classroom. List the names on the board or a transparency. Ask the students to

define "object." If some of the children appear to be having trouble, remind them that the definition of object is a "thing." Put 4 or 5 of the small objects that are named on a desk near the children. Have them discuss how they are alike and different. Using the board or transparency, the teacher should record the students' responses within each category.

Objects	How (same or different)
Same Pencil, book, cup	Color
Different Pencil, cup	Shape

6. Have the children turn to page 3. They are to read the cluster title and then the lesson head.

7. Have the children read page 3. The teacher may paraphrase the text and use Language Cards to facilitate communication. For a few minutes have the children examine the picture and then discuss the page with them. Emphasize the great number and variety of objects shown.

8. Make sure the children understand that an object is "any lump of matter." Teacher should use Language Cards. The word object is a general term for any recognizable unit of material substance, large or small. (For many children this may be a review.)

DESIRED LEARNING OUTCOME: The children should be able to name and list a variety of objects in the environment.

****

DEVELOPMENT: Lesson Cluster 1A-1 Sampling and Estimating
Page T-26/S-4 Samples (30-40 min.)

PURPOSE: To introduce and develop the process of sampling.

PREREQUISITES: Ability to identify physical characteristics of objects and animals.

ADVANCE PREPARATION: Materials -container
-5 marbles for each child

Language Cards/Key Signs
sample
insects
property
moths
common property

TEACHING SUGGESTIONS:

1. Do the following: Put 5 marbles in a containers for each child. The marbles should be of different colors and patterns. Give each child a container of marbles.

2. Encourage each child to describe the characteristics of their sampling of marbles. Such things as size, shape, color, pattern, and so on, will be forthcoming.

3. Have the children name those characteristics that are common to all cups (samples)

of marbles. You may wish to list them on the chalkboard.

4. Have the children read page 4. The teacher may paraphrase the information as well. Use Language Cards to facilitate communication.

5. Have the children study the pictures on page 4 for a few minutes. Ask the children if they can identify any of the insects. Record correct responses on the board.

6. Help the children to understand that all insects are alike in some ways. They have common properties. Use Language Cards and point out that finding common properties is the same as telling how things are alike. For example, one property is that most insects have two pairs of wings in the adult stage.

7. Ask the children which insects on page 4 show two pairs of wings.

8. Ask the children why two pairs of wings cannot be seen on the other insects shown. (Because of the way the insects were photographed, their wings are not visible.)

9. Help the children to understand that another common property of most insects is having three pairs of legs in the adult stage.

10. Ask the children which insects on page 4 show six legs.

11. Help the children to understand that another common property of most adult insects is a pair of antennae, or feelers, extending from the head.

12. Ask the children which insects on page 4 show a pair of antennae.

13. Use some mounted insect specimens, if you wish, as an aid to show those properties you have stressed in the discussion of an insect sample.

14. Have the children study the moths shown on page 5 for a few minutes.

15. Ask the children to name the properties in each moth pictures that tell that it is an insect. (Two pairs of wings and two feelers.)

16. Ask the children what property of insects that was discussed cannot be seen on any of the moths. (Three pairs of legs.)

17. Use a mounted moth specimen, if you wish, to illustrate properties of moths.

DESIRED LEARNING OUTCOME: The children should be able to identify a specific kind kind of object from samples.

****

DEVELOPMENT: Lesson Cluster 1A-1 Sampling and Estimating
Page T-28-29/S-5 Estimating/How Many Marbles? (30-40 min.)

PURPOSE: To apply the process of sampling to estimating quantity from smaples. To reinforce the ability to make number estiamtes from samples.

PREREQUISITES: Addition of four numbers.

ADVANCE PREPARATION: Materials -About 50 small objects such as:
- -beans
- -peas
- -buttons
- -paper clips

For each child:
- -egg carton, cut so that it has 4 sections intact
- -cardboard egg carton corner, cut so that when placed over the 4 sections, the objects in 1 section remain visible (see Figure 1 for example)

Language Cards/Key Signs

estimate
sample

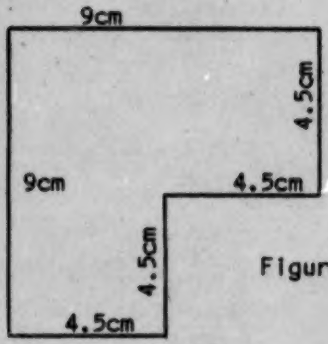

Figure 1

TEACHING SUGGESTIONS:

1. Put a sampling of objects in the 4 sections of each student's carton.

2. Ask them about how many objects there are in the carton.

3. Explain to the students that they can find out how many objects are in the whole carton by only counting the objects in 1 section.

4. Have each student count the objects in 1 section and add it 4 times since there are 4 sections.

5. Explain that they have found the estimate. Use the Language Card to facilitate communication.

6. Have them count the total number of objects to see how close their estimate is.

7. Have the children study page 6.

8. Have them estimate the number of marbles in the tray. As they make their estimates, you may wish to record their estimates on the chalkboard.

9. Discuss the results and help the children to understand that making sampling estimates is much faster and easier than counting all the objects - in this case, all the marbles on the tray.

10. Ask the children if they can explain the difference between making a guess and making an estimate as to how many marbles are on the tray.

11. Explain, if necessary, that while an estimated total is not exact, it is still

better than a guess. In a guess, no sampling is done, so the number guessed can be very different from the real total.

12. Repeat step 1 using a different distribution of objects.

13. Place the cover over the carton so that one section is exposed.

14. Proceed as in steps 3 through 6.

15. Repeat this activity as many times as you feel is necessary so that the children are secure in their understanding of sampling estimates.

DESIRED LEARNING OUTCOME: Ability to make estimates of quantity from samples.

****

APPLICATION: Lesson Cluster 1A-1 Sampling and Estimating
Page T-30/S-7 Estimating Size (20-30 min.)

PURPOSE: To apply the process of estimating to the size of objects.

ADVANCE PREPARATION: Materials -text
-blackboard or transparency

Language Cards/Key Signs
estimate
size
giraffe

TEACHING SUGGESTIONS:

1. Let the children study the picture showing the man and giraffe on page 7 for a few minutes. Then discuss the comparisons and estimate the height of the giraffe. Teacher should demonstrate on the board or a transparency how the estimate was found.

2. Point out that sizes are always described in comparisons with another object or unit of measure (which is also an object). Estimated sizes are often sufficient for many purposes.

3. Have the children study the girl and the tree in the picture. Then discuss the comparisons and estimate the height of the tree.

4. Challenge the children to estimate the size of some objects in the classroom. Designate objects with regular divisions or markings if possible, such as a floor or wall of tiles, or a window of a number of panes.

5. Write the size of the units on the chalkboard. Discuss the estimates when the children have finished.

DESIRED LEARNING OUTCOME: Ability to make simple estimates of size.

****

EVALUATION: Lesson Cluster 1A-1 Sampling and Estimating
Page T-31/S-8 Samples and Estimates (20-25 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:

1. Describing and discussing the common properties of a group of objects from observation of samples.
2. Estimating from samples the number of objects in a large group.

Language Cards/Key Signs
estimate
sample
bank
pennies

TEACHING SUGGESTIONS:

1. Refer the children to page 8. Have them read the first question and look at the picture. The teacher may paraphrase the question in order to facilitate communication.

2. Write the answers volunteered by the children on the chalkboard. The board list can contain a variety of answers.

3. Determine if all children have developed enough of an understanding of properties common to each of the piggy banks shown. Record the correctness of each response on Student "Wrap Up" Record Sheet.

4. Have the children read the second question and look at the picture. Paraphrase the question if necessary.

5. Ask how many pennies there are in the stack shown.

6. Have the children estimate how many units of pennies are needed to reach the top of the container. Record the correctness of each response on Student "Wrap Up" Record Sheet.

7. If a child correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 3 Unit 1 Variation

Part A Variation in Objects, Lesson Cluster 1A-2

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-37	Enrichment	Sorting Collections	20-30 min.
T-36	Introduction	Grouping by Properties	20-30 min.
T-38	Development	The Two Big Groups	20-30 min.
T-40	Development	Alike in Several Ways	20-30 min.
T-42	Application	Sample Groups	20-30 min.
T-44	Evaluation	Find the Groups	20 min.

B. MATERIALS: See list on page T-33.

FILMSTRIP INFORMATION: Filmstrip Set VI, Variation, is appropriate for use in this unit.

ENRICHMENT: Lesson Cluster 1A-2 Grouping Objects
Page T-37 Sorting Collections (20-30 min.)

PURPOSE: Provide practice in grouping by properties.

PREREQUISITES: Ability to sort objects using different properties.

ADVANCE PREPARATION: Materials -student collections (stamps, rocks, cards, etc.)

Language Cards/Key Signs
properties of groups which children have sorted

TEACHING SUGGESTIONS:

1. Have the children spread their collections and begin sorting them by whatever properties they wish.

2. Children who did not bring collections may be paired with those who did.

3. Move among the children and show interest in their collections and in how they have grouped the objects therein by properties.

4. Have the children keep a record of the properties of their groups.

5. Now challenge the children to sort their collections in a different way or ways.

6. You may wish to have one or more children explain ways in which they sorted their collections to the class. Perhaps one child has grouped a stamp collection by country, by subject, or by shape. Or perhaps another child has grouped a collection of baseball cards by team or by position.

DESIRED LEARNING OUTCOME: Ability to sort collections of like objects into groups by common properties.

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INTRODUCTION: Lesson Cluster 1A-2 Grouping Objects
Page T-36/S-9 Grouping by Properties (20-30 min.)

PURPOSE: To review the process of grouping by properties and to reinforce the grouping done in the previous lesson.

PREREQUISITES: Ability to notice similarities within a group of objects.

ADVANCE PREPARATION: Materials -assortment of buttons for each pair of children

*Advance preparation for the next lesson, The Two Big Groups - put together a collection of both living and non-living objects.

Language Cards/Key Signs
group/groups
property
a button/buttons

TEACHING SUGGESTIONS:

1. Divide the class into pairs. Give a cup of buttons to each pair of children.

2. Challenge the children to sort the contents of each cup into groups.

3. Move among the children to note their groups and to comment on the differences in the several kinds of buttons.

4. You may wish to have the children put their buttons back into the cups and have them switch cups. They can then sort the buttons from the "new" cup into groups.

5. Repeat the sorting exercise until you feel the children have grasped grouping by properties.

6. Have the children read and study page 9 for a few minutes.

7. Lead a class discussion of the page. Be sure that all the children understand the property on which each pictured group is based. Emphasize that grouping is important to science because of the many kinds of objects there are in the world to be studied.

DESIRED LEARNING OUTCOME: Ability to group objects by common properties and identify the basis for groups already formed.

****

DEVELOPMENT: Lesson Cluster 1A-2 Grouping Objects
Page T-38/S-10 The Two Big Groups (20-30 min.)

PURPOSE: Review process of grouping and develop an appreciation of its importance. To identify objects as living or non-living and group accordingly.

PREREQUISITES: The ability to differentiate a living from a non-living object.

ADVANCE PREPARATION: Materials -collection of living and non-living objects

Language Cards/Key Signs
living
scientist
lock
lizard
snake
cactus
non-living
flashlight
airplant
butterfly
rabbit
alarm clock

TEACHING SUGGESTIONS:

1. Display the collection of living and non-living objects. Ask the students about possible groupings for these

objects. Encourage the students to explore the concept of living and non-living objects. Emphsize these groups as the students discover them. Discuss the characteristics of living vs. non-living objects.

2. Have the children read page 10 and look at the two groups shown at the tops of page 10 and 11. Use the word cards to reinforce this vocabulary.

3. Using a transparency, have the children list the names for the objects on each of the pages. Then, have the children discuss each object and if it is non-living or living.

4. Give each child a piece of paper. Have them divide the paper into two sections, labeling them living and non-living. Using the vocabulary words from the transparency, have the children divide the objects into two groups. (Or you may wish to assemble the two groups object by object through discussion and a vote by show of hands.)

5. Observation of objects in the classroom can be an additional reinforcement step. What living objects can be seen? What non-living objects? Stress the point that one way in which objects can be grouped is by whether they are living or non-living.

6. For more exposure to a variety of objects in the environment, take a walk around your school building, both inside and outside. Have the students identify living and non-living objects and keep a record of those objects seen. The record could be either written, drawn or a photograph could be taken.

DESIRED LEARNING OUTCOME: Ability to identify and discuss living and non-living as two categories into which objects can be grouped.

****

DEVELOPMENT: Lesson Cluster 1A-2 Grouping Objects
Page T-40/S-12 Alike In Several Ways (20-30 min.)

PURPOSE: Continue to develop process of grouping and to identify its uses in science.

PREREQUISITES: The ability to group objects by more than one property.

ADVANCE PREPARATION: Materals -pictures of insects and/or specimen samples, possibly by the students

Language Cards/Key Signs
to belong
an insect
feelers (antennae)

TEACHING SUGGESTIONS:

1. Using picture cards and/or specimens which have been collected, discuss the characteristics of the insects. Remind the children that they have discussed these things earlier in the book (page 4).**

2. Have the children read the title on page 12. The students can then read the text or the teacher can paraphrase it. A discussion of the information in the text should follow, to assure comprehension of the material.

3. Using a transparency or the blackboard, have the children list those properties they find in the pictured insects. You may wish to raise questions about them such as these: On which insects can you see the wings? If wings can't be seen,

how do you know the other animals shown are insects? (Six legs and two antennae can be seen.)

4. Now have the children look at the group of animals shown on page 13. Which of the animals pictured belong to the insect group? How are the ones they think are insects like the insects shown on page 12?

5. Ask the question, How do you know which animals are not insects? (By counting legs. The two spiders each have eight legs, and the centipede has many more than six.)

DESIRED LEARNING OUTCOME: Ability to identify the common properties of a group and identify other objects with those properties.

**When using the specimens or pictures, additional properties of insects can be pointed out. All adult insects have three body parts (head thorax and abdomen). Non-insects such as spiders, do not.

****

APPLICATION: Lesson Cluster 1A-2 Grouping Objects
Page T-42/S-14 Sample Groups (20-30 min.)

PURPOSE: To identify properties of a group and to recognize the properties of that group.

PREREQUISITES: The ability to match properties of objects.

ADVANCE PREPARATION: Materials -assorted leaves

Language Cards/Key Signs
red oak
white oak
shingle oak
sample

TEACHING SUGGESTIONS:

1. If possible, have the students collect a variety of leaves, from the trees shown on page 14 and from other trees. Have the students group their leaf samples. Some children might enjoy mounting sample groups of three or four of each kind of leaf on heavy paper. Use the Language Cards to reinforce the names of trees. Have the children write the names of the trees on the card. Bulletin board displays might be made from such group collections. (Note: If leaves are not available, they could be cut from colored photographs.)

2. Tell the children to study page 14 carefully so that they can identify the three kinds of leaves pictured. Have them use the black and white drawings of the single leaves as a help in telling about the properties of the leaves shown in the color photographs.

3. Differences in the three samples shown in black and white can be noted. For example, the white oak leaves have rounded lobes, the red oak pointed lobes, the shingle oaks no lobes.

4. Once properties have been established for a sample, those properties can be applied to the color groups on the page. (Each leaf in the group has the same properties.)

5. Matching properties is accomplished by identifying leaves from the random sampling shown on page 15 with the three identified groups shown on page 14.

6. Have each child explain the reasons for the identification of the leaves in the random sample. Encourage the use of the tree names during the discussion.

DESIRED LEARNING OUTCOME: Ability to describe from samples the identifying properties of objects of a specific kind and identify other examples of the group.

****

EVALUATION: Lesson Cluster 1A-2 Grouping Objects
Page T-44/S-16 Find the Groups (20 min.)

PURPOSE: To evaluate performance in relation to the following objectives:

1. Observing and identifying the common properties of objects so they can be arranged in groups.
2. Discussing and comparing the properties of living and non-living objects so they can be grouped.

ADVANCE PREPARATION: Materials - an assortment of coins and three potted plants
- Teacher-made student answer sheet

Language Cards/Key Signs
to notice
rough
hard
striped

TEACHING SUGGESTIONS:

1. Begin with the following activity using a random assortment of coins and approximately three potted plants.

2. Spread the coins out in a group on a table. On another table, arrange the three potted plants.

3. Ask the children to look at the two groups. Ask them to identify whether the groups are of living or non-living objects. Have the students record their answers on an answer paper.

4. Have the children identify those properties common to the objects in each group. Again, have the children write their answers on an answer paper. Go around to the children and assist them with any spelling problems. You should get an assortment of good answers.

5. Explain to the children to look at page 16. Use the Language Cards to explain the vocabulary on that page. Discuss the words, to be sure that the children understand the terms. Have the children give the names for the groups which are present. Write these names on the board.

6. Have the children answer the questions by writing their responses on their answer paper.

7. When the children have completed their responses, discuss each statement and the correct responses with them.

8. Accept all reasonable answers to the third statement. Through discussion have children develop understandings of those common properties that are evident.

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Level 3 Unit 1 Variation

Part A Variation In Objects, Lesson Cluster 1A-3

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-50	Introduction	What is Variation?	35-40 min.
T-51	Enrichment	Variation in Collections	25-35 min.
T-52	Development	Finding Variation	35 min.
T-56	Application	Variation Everywhere	30-40 min. (+2 hrs. for trip)
T-58	Evaluation	Find the Variation	20-30 min.

B. MATERIALS: See list on page T-47.

FILMSTRIP INFORMATION: Filmstrip Set VI, Variation, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1A-3 Variation in Groups
Page T-50/S-17 What is Variation? (35-40 min.)

PURPOSE: Introduce concept of variation.

PREREQUISITES: The ability to notice different properties in a group of similar objects.

ADVANCE PREPARATION: Materials -assortment of beans, bags, paper cups

Mix bags of several seeds together, such as beans, peas, and corn. Then partially fill enough paper cups to supply one to each group of two children. Also use the textbook and blackboard.

Language Cards/Key Signs
exactly alike
variation
size
color
shape
pattern

TEACHING SUGGESTIONS:

1. Give the children the cups of seeds. Have the children work in groups of two.
2. Challenge them to sort the seeds in their cups into groups. Move among the children to note their groups and to comment on the differences in the several kinds of seeds. List the names of the different seeds on the board.
3. Ask the children to carefully examine the seeds in one group (name a specific kind for all to use first) to see if all the seeds are exactly alike. Use the Language Card, and discuss the term "exactly alike."
4. Ask how the seeds differ - in what properties. List the properties on the board. Discuss each word as it is mentioned. Discuss how the properties vary.

5. Note that although properties such as size, shape, color, pattern, and texture may differ only a little, the seeds are not exactly alike in these properties. The seeds show variation in these properties, even though they are enough alike to be in the same group.

6. Have the children turn to page 17 in their books. Ask them to look at the picture of the butterflies and study it for a few minutes.

7. Have the children read the title of the page. The teacher should then read the text to the students, explaining the concepts covered and the vocabulary included as it is read. Write the words size, color, shape and pattern on the board.

8. Discuss variation in the butterflies with the class. Have the students explain the variation according to the properties that are listed on the board.

9. Emphasize that differences in members of a group are known as variation. Use the word card as this is done. Point out that the amount of variation may be great or very little. The general shape of the butterflies, for example, is the same. The shapes, however, are not exactly the same. There is a variation in shape.

DESIRED LEARNING OUTCOME: Ability to identify and describe variation within groups.

****

ENRICHMENT: Lesson Cluster 1A-3 Variation in Groups
Page T-51 Variation in Collections (25-35 min.)

PURPOSE: Provide additional development of the concept of variation.

PREREQUISITES: To be able to notice variety within a property of an object.

ADVANCE PREPARATION: Materials
- collections of objects, done by the teacher or brought in by the students
- bottle caps
- baseball cards
- gum wrappers, etc.

Language Cards/Key Signs

TEACHING SUGGESTIONS:

1. Have the children group the objects by general properties, i.e., all baseball cards together.

2. Take one group of objects. Have the children study the objects.

3. Using a transparency or board, have the children list the properties of the group. Discuss the degree of variation within each of these properties.

4. Do this activity with the other groups of objects. Continue until the children are comfortable with the concept of variation within familiar groups of objects.

5. If you wish, you may suggest that they arrange their collections in order by variation in a property. For example, objects varying in size can be arranged from largest to smallest (or the reverse). Objects varying in shade of a color can be arranged in graduated sequence.

DESIRED LEARNING OUTCOME: Ability to identify and describe variation within a group.

****

DEVELOPMENT: Lesson Cluster 1A-3 Variation in Groups
Page T-52/S-18 Finding Variation (35 min.)

PURPOSE: Continue development of concept of variation.

ADVANCE PREPARATION: Materials
-collections of bolts, shells, rocks
-student text
-transparency or chalkboard
-collections of objects similar to the ones on pages 18-19 of the text

Language Cards/Key Signs
surface
bolts
shells
rocks
rough
smooth
bumpy

TEACHING SUGGESTIONS:

1. Place the collection of bolts on a large table. Have the children sit around the table, so each can look at and touch the objects.

2. Allow the children a few minutes to explore the objects on the table. Ask them to note different properties of the bolts.

3. After the children have had enough time to manipulate the objects, have the children list the properties of the bolts. Discuss the variation within each property. The properties can be written on a transparency or on the board, and the variations noted.

4. Quickly go through the same activity with the shells, and then the rocks.

5. Ask the children to look over pages 18 and 19.

6. Read the text to the class, using the word cards to reinforce new vocabulary. Emphasize the word "surface" because this is a new property. Include vocabulary words describing surface.

7. Explain that they are to see how many properties with variation they can find in each of the three groups.

8. List the properties on a transparency. When they have finished making the list, discuss the variation in each group. Call on children to describe specific variations.

9. Be sure to mention the less obvious variations such as the several types of heads and the amount of threading on the bolts.

10. Point out also, that even properties that are alike in a general way really show variation. Examples are the materials of the rocks and the shapes of the shells.

11. Now (or for homework) have the children find collections of objects that show variation. Possible collections are boxes of crayons, pencils, books, and

specific items of clothing. The children's shoes, for example, probably will show considerable variation in size, texture, materials, color, and wear.

12. Emphasize that objects that seem alike at a glance usually show some variation when observed closely.

DESIRED LEARNING OUTCOME: Ability to identify and describe variation within a group.

* * *

APPLICATION: Lesson Cluster 1A-3 Variation in Groups
Page T-56/S-22 Variation Everywhere (30-40 min. plus 2 hrs. for trip)

PURPOSE: Apply concept of variation to objects found in children's environment.

ADVANCE PREPARATION: Materials -scissors
-textbook

Provide old picture magazines and scissors for the class. (As an alternative activity, if possible, plan trip into the community.)

Language Cards/Key Signs
everywhere
somewhat alike
smooth
rough
hairy
bumpy

TEACHING SUGGESTIONS:

1. If possible, take a field trip into your community. Have the children discuss the variations which they see in their environment. Take photographs of those objects observed.*

2. Take the photographs from the trip and make a bulletin board for the students to look at and discuss. If the trip was not possible, have the students cut pictures from magazines, and discuss the variation within each picture. Again, make a bulletin board from these pictures.

3. Discuss pages 22 and 23 with the class. Relate what was seen on the field trip or in the magazines to these pictures. Encourage children to tell about variations they have noticed in objects around them.

4. It is important that the children begin to notice the finer differences in the details or similar objects and become aware that it is highly unlikely that any two objects are exactly alike in all properties.

5. Ask the children to review the properties of different surfaces. Discuss those surfaces noticed on the trip, or of objects in the classroom. List the properties on a transparency.

6. Ask the students to identify the surfaces of the objects in the pictures on pages 22-23. Ask the question, How do you find out about surfaces of objects? (Generally through touch, and then by applying that knowledge when describing surfaces of pictured objects.)

7. As an additional activity, children could make up collections of pictures showing variation in the historical development of such things as automobiles, bicycles, telephones, houses, and so on.

8. You may wish to make bulletin board or wall displays of the picture collections that best illustrate the concept of variation. These displays can then serve as

a continuing reminder to the class of the variation concept.

DESIRED LEARNING OUTCOME: Ability to name and illustrate examples of variation in the environment.

*Have the students pay specific attention to the surface of objects.

****

EVALUATION: Lesson Cluster 1A-3 Variation in Groups
Page T-58/S-24 Find the Variation (20-30 min.)

PURPOSE: To evaluate the children's performance in relation to the following objective:

1. Identifying variations in properties among the objects within a group.

ADVANCE PREPARATION: Materials -textbook (page 24)
-student answer sheet

TEACHING SUGGESTIONS:

1. Read page 24 with the children. Answer any questions they have about the vocabulary.
2. Have each child answer the two questions on the student answer sheet.
3. When the children have completed their responses, discuss each answer with them.
4. If a child correctly responds to the two questions, you may assume that he/she has demonstrated the objective for the cluster and is ready to go on to the next cluster.

****

Level 3 Unit 1 Variation

Part A Variation in Objects, Lesson Cluster 1A-4

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-64	Introduction	Order and Range	35-40 min.
T-72	Enrichment	Histogram Practice	35-40 min.
T-66	Development	Making a Histogram	35-40 min.
T-68	Development	Measuring Variation	35-40 min.
T-69	Application	Variation in Your Class	35-40 min.
T-70	Evaluation	Find the Variation	20-30 min.

B. MATERIALS: See list on page T-61.

FILMSTRIP INFORMATION: Filmstrip Set VI, Variation, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1A-4 Describing Variation
Page T-64/S-26 Order and Range (35-40 min.)

PURPOSE: Introduce more precise techniques for observing variation.

PREREQUISITES: The ability to place objects in order by variation within one property.

ADVANCE PREPARATION: Materials -ten collections of four to five objects showing variation, such as paper squares, paper clips, crayons, sandpaper pieces
Place each group of objects in a can or small box.

Language Cards/Key Signs
- order
- light green
- dark green
- lightest
- darkest
- range
- pea pods
- smallest
- largest

TEACHING SUGGESTIONS:

1. Ask the class to stand at the front of the room. Arrange the children in order in a row by a property such as height or color of clothing. (Avoid sensitive areas.)

2. When you have an ordered row, describe the variation by using the Language Card for order and discussing the concept.

3. Then ask all but the first and last children to sit down. Use the Language Card for range and discuss that concept. This should emphasize in a simple, clear way the value of range in describing variation.

4. Pass out to each group of two students one of the collections of objects you have assembled in cans and boxes. Have the children sort the collection by order and

then range. Ask the children to place the objects in order. Use the card and sign to reinforce the word. Then do the same thing for "range."

5. Circulate among the groups, asking the children specific questions about their collections.

6. Have the children look at page 26. Read the page to the children, and discuss the page, step by step. Use the Language cards during both the reading and discussion.

7. Have the children look at page 27. Read or paraphrase the information to the children. Discuss the concepts of order and range.

8. Some children may volunteer to make poster displays of order and range similar to those shown in the book on pages 26 and 27. For example, objects from the collections can be pasted or taped on heavy paper and then labeled.

DESIRED LEARNING OUTCOME: Ability to order objects of a group by a specific property and state the range in terms of extremes.

****

ENRICHMENT: Lesson Cluster 1A-4 Describing Variation
Page T-72 Histogram Practice (35-40 min.)

PURPOSE: To develop the ability to prepare simple histograms.

ADVANCE PREPARATION: Materials
- -Historagm form for each student (Appendix A)
- -seeds or other objects placed in cups (enough for each child)
- -transparency of the histogram

Language Cards/Key Signs
labels for the seeds (or other objects) used in the histogram
histogram
number of seeds

TEACHING SUGGESTIONS:

1. Pass out one cup of seeds (or other objects) to each child. Have the children pour out the seeds onto their desks.

2. Ask the students to group the seeds, and then count them. Use the Language cards to label the types of seeds.

3. Pass out the histogram forms. Ask the students how they could show the information about the seeds on this piece of paper.

4. Use a transparency of the histogram form. Have the children write the appropriate labels on the transparency. Then instruct the children to make their own histogram with the seeds that they have.

5. Move among the children to check on their progress and to give assistance.

6. When the children have finished, discuss the histograms that they have made. Make a bulletin board with their histograms.

7. The children could do additional histograms of objects they have at home, or in their desks at school.

DESIRED LEARNING OUTCOME: Ability to construct simple histograms.
****

DEVELOPMENT: Lesson Cluster 1A-3 Describing Variation
Page T-66/S-28 Making a Histogram (35-40 min.)

PURPOSE: To reinforce the children's understanding of making and reading histograms.

PREREQUISITES: The ability to record data on a histogram.

ADVANCE PREPARATION: Materials:
-textbook
-transparency of page 29
-seeds listed in lesson

TEACHING SUGGESTIONS:

1. Show the children the seeds that are on page 28. (Have the real seeds if possible.) Use the Language Cards to identify the names of the seeds.

2. Have the students look at page 28. Read the text to the children. Have the students count the number of each type of seed. Encourage the children to use the proper names for the seeds.

Language Cards/Key Signs
histogram
kind
a shaded block
lima bean
sunflower seed
corn
pea
squash
kidney bean
a block
the smallest number
the most

3. Use a transparency of the histogram on page 29. Read or paraphrase the information to the children. Use the Language Cards when appropriate.

4. Discuss the labels on the histogram. Have the children shade in the appropriate areas according to the seeds on page 28. (On the transparency)

5. Ask the questions on page 29. Discuss each answer with the children.

6. Now ask the children to answer the same questions asked on page 29 using the picture of the group of seeds on page 28 instead of the histogram pn page 29.

7. After the children have discussed and answered the questions, ask the following: Which is easier to use for answering the questions, the picture of the group of seeds or the histogram?

8. Through discussion have the children realize that a histogram can be a very effective way of presenting data in readable form.

DESIRED LEARNING OUTCOME: Ability to read data from a simple histogram.
****

DEVELOPMENT: Lesson Cluster 1A-4 Describing Variation
Page T-68/S-30 Measuring Variation (35-40 min.)

PURPOSE: Measure and record variation.

PREREQUISITES: Measuring with a centimeter ruler, using a two pan balance scale.

ADVANCE PREPARATION: Materials
-centimeter rulers
-pieces of string

Materials -potato for each child
-two pan balance scales
-washers
-paper (student recording sheet)

Draw three histogram forms on the board or use transparencies.

Language Cards/Key Signs
to measure
the eye of a potato
a piece of string
distance
a centimeter ruler
a washer
variation
a centimeter

TEACHING SUGGESTIONS:

1. Give each child a potato, a piece of string and a centimeter ruler.

2. Tell the children to look at page 30. Using the Language Cards, read and discuss each set of directions, one at a time. After completing the first set of directions, have the children do that measurement task. Then go on to the second set of directions and the measuring task.

3. Have the children record their answers on the recording sheet. Tell them that you will need the information later in the class.

4. NOTE: When discussing the "eyes" you can tell the children that these are the spots where new plants will start growing if the potatoes are planted.

5. When the children have made all of the measurements, make use of the histograms which you drew on the board. On one histogram record the class data on potato eyes, on the second record distances around the potato and on the third the number of washers needed to achieve balance.

6. When the histograms are complete, have the class read them to find data you request. They can find the greatest, the smallest number, and the range for each property.

DESIRED LEARNING OUTCOME: The children should be able to make simple measurements of number, size and mass. They should also be able to read information from a histogram.

****

APPLICATION: Lesson Cluster 1A-4 Describing Variation
Page T-69/S-31 Variation In Your Class (35-40 min.)

PURPOSE: Apply concept of variation and its measurement to everyday objects.

PREREQUISITES: Be able to read information from a histogram, and to record information on one.

ADVANCE PREPARATION: Materials -a centimeter tape measure or meter stick marked off in cm
-histogram form for each child

Language Cards/Key Signs
height
to describe

1. Tape the ruler to the wall of the classroom.
2. Reproduce the histogram forms.
3. Draw one form on the board or use a transparency.

TEACHING SUGGESTIONS:

1. Ask the children to look at page 31. Read the page to the class and then choose children to read the text. Use the Language Cards for the new vocabulary.

2. Have each child's height measured by a classmate. Have the children record that information on the chalkboard or transparency. Pass out the histogram forms for the children to label and fill in.

3. Suggest to the children, if they aren't already aware of it, that the histogram is to show variables of height in the class, not what the height of each child is individually.

4. When the measurements have been made and the histograms are complete, lead the class in a discussion of the range of height.

DESIRED LEARNING OUTCOME: Ability to measure height and record class data concerning height on a histogram.

****

EVALUATION: Lesson Cluster 1A-4 Describing Variables
Page T-70/S-32 Find the Variation (20-30 min.)

PURPOSE: Evaluate performance in relation to the following objectives:
1. Reading and interpreting a histogram.
2. Describing the range of a property in a group ordered by that property.

ADVANCE PREPARATION: Materials -student answer sheet
-centimeter ruler

Language Cards/Key Signs
length

TEACHING SUGGESTIONS:

1. Ask the children to look on pages 32 and 33. Discuss the concept of length, and explain that the histogram is based on the lengths of fish.

2. Ask the children to answer the questions by placing their answers on the student answer sheet.

3. When the children have completed their responses, discuss each one with them.

4. If a child correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 3 Unit 1 Variation in Objects

Part B Variation in Matter, Lesson Cluster 1B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson	Teaching Time Suggested
T-79	Enrichment	Collecting Samples of Matter	35-40 min.
T-78	Introduction	What Are Objects Made Of?	35-40 min.
T-80	Development	Properties of Matter	35-40 min.
T-82	Development	Variation in Wood	35-40 min.
T-84	Application	Raw Materials	40-45 min.
T-86	Evaluation	Choose the Matter	20-25 min.

B. MATERIALS: See list on page T-75

FILMSTRIP INFORMATION: Filmstrip Set VI, Variation is appropriate for use in this unit.

ENRICHMENT: Lesson Cluster 1B-1 The Matter in Objects
Page T-79 Collecting Samples of Matter (35-40 min.)

PURPOSE: To provide an opportunity for the children to collect and manipulate objects and to explore the nature of these objects.

ADVANCE PREPARATION: Materials - 1. Objects can be collected by the children at home, or before the lesson begins. Set aside space on a table or desk where these objects will be grouped and labeled.

Language Cards/Key Signs
metal
wood
glass
plastic
What is this object made of?

TEACHING SUGGESTIONS:

1. Ask each child to "show and tell" the objects he/she brought to class.

2. Have a child hold up an object. Ask the question: What is the object made of?. Use the language card to reinforce this. Help the children with the first few answers if necessary.

3. Challenge the other children to see if they have a sample of the same material. If so, they can hold it up for all to see.

4. From time to time stress the various categories of matter and point out that all objects are made of one or more of these things.

5. Use the language cards for metal, wood, etc. and have the children sort the objects into the appropriate groups. Use this for a display which would be used during this cluster.

LEARNING OUTCOME: Ability to collect and group samples of a variety of materials.

* * *

INTRODUCTION: Lesson Cluster 1B-1 The Matter In Objects
Page T-78/S-35 What Are Objects Made Of (35-40 min.)

PURPOSE: Reinforce the concept of matter.

PREREQUISITES: The ability to state what an object is made of.

ADVANCE PREPARATION: Materials - textbook, various objects around the room, samples of objects from previous lesson.

Language Cards/Key Signs
matter
wood
glass
plastic

TEACHING SUGGESTIONS:

1. Write the word MATTER in large letters on the board or a transparency.

2. Ask the children if they know what matter is. Ask them to give you examples of kinds of matter. Make a list of these things.

3. Ask the children to look at page 35. Instruct them to pay close attention to the objects in the picture. Have children take turns reading the text.

4. Ask the children to name the objects in the picture. Write these on the board (transparency), with the following chart:

Object	What is it made of?

5. Fill in the chart with the objects and the materials of which they are made.

6. You might find it helpful to suggest various categories of matter from time to time as the discussion continues. Some general categories that could enter into the discussion are: iron, stone, fibers, plants, animals. You will notice that it is unnecessary to be concerned with strict categories of matter. The objective is awareness, recognition, and description of matter of which objects are made.

LEARNING OUTCOME: The children should be able to identify what general type of matter an object is made of.

* * *

DEVELOPMENT: Lesson Cluster 1B-1 The Matter In Objects
Page T-80/S-36 Properties of Matter (35-40 min.)

PURPOSE: Continue to develop the concept of matter and its variation.

PREREQUISITES: The ability to compare properties of objects.

ADVANCE PREPARATION: Materials - have on hand all of the materials shown on page 36, student worksheet (p. 37), transparency of chart (p. 37), 10 cm long pieces of wire - three different kinds.

Language Cards/Key Signs
to compare / an example
light
heavy
hard
soft
bend
break
wire
to number over and over
(and labels for objects used during the discussion)

TEACHING SUGGESTIONS:

1. Use the word cards for light and heavy. Show the children a variety of objects. Have the children put each object in a tank filled with water. Ask each child - Is the object heavy or light?

2. Use the language cards hard and soft. Let each child hold the cotton and the rock. Ask the children - Which object is hard/soft?

3. Again use the language cards for bend or break. Permit each child to manipulate the wire and chalk. Ask the question - Which object will bend/break?

4. Ask the children to look at page 36. Ask the children to read the sentences from the text. Emphasize that certain properties of objects are given by the material of which they are made. Such properties as color, texture, hardness, mass and flexibility are different with different materials.

5. Some properties can be seen easily. Others are hidden and are only observed when the object interacts with other objects. Such interactions are used to test for these hidden properties. Testing the wire samples for flexibility is an example of this.

6. Explain the experiment on page 37. Write the directions on the board using language appropriate to your children. Have the children read the directions before starting the task. Pass out the record sheets to the children.

7. Ask the children to work in pairs. Distribute three wires to each pair. One child is to be the counter (marking the counts on paper), the other will bend the wire.

8. The number of flexes necessary to break the wires will depend on the material and gauge of the wire used. Show the children how to flex the wires in a uniform fashion so each wire is treated in the same manner. Caution them to count the flexes and keep a careful record.

9. Ask the children to do the experiment, and then to write the numbers on their charts.

10. When all the children have finished, discuss the results of their tests and then sequentially order the wires for flexibility.

LEARNING OUTCOME: Ability to test, compare and describe a specific property in different materials.

* * *

DEVELOPMENT: Lesson Cluster 1B-1 The Matter In Objects
Page T-82/S-38 Variation in Wood (35-40 min.)

PURPOSE: Further develop concept of variation.

ADVANCE PREPARATION: Materials - Wood blocks - try to obtain three different kinds that vary in hardness. Sandpaper - for each child.

Language Cards/Key Signs
pine
redwood
sandpaper
a sample
to rub
hardness

TEACHING SUGGESTIONS:

1. Place the various pieces of wood on a table. Have the children seated around the table. Ask them to compare the pieces of wood (color, texture, etc.).

2. Ask the children which they think is the hardest wood. Discuss how you could find out if wood is hard.

3. Take out the sandpaper. Again ask the children how this could be used to determine the hardness of the wood.

4. Use page 39 as a reinforcement activity, to show the children the correctness of their idea. Read the page to the children, using the language cards where appropriate.

5. Before the children begin sanding, you may wish to illustrate the use of sandpaper squares on a block of wood to the class as a model for them to follow.

6. Remind the children that when sanding, the wood should be rubbed the same way, and that each piece of wood should be rubbed the same number of times.

7. When all the children have finished testing, discuss the results and sequentially order the types of wood from hardest to softest, if possible.

8. Continue that discussion by looking at page 38. Ask the children questions about the pictures of the wood blocks. Be sure to emphasize that samples of the same general kind, such as wood, can show variation in their properties. The variation of wood stressed in this lesson is the property of hardness.

9. As you discuss page 38, remind the children that the sandpaper was used in the same way on each block of wood. Therefore, the way in which the sandpaper was used was a constant. Only the blocks of wood are varied in terms of the property hardness.

DESIRED LEARNING OUTCOME: Ability to test, compare and describe a specific property in samples of the same kinds of material.

* * *

APPLICATION: Lesson Cluster 1B-1 The Matter In Objects
Page T-84/S-40 Raw Materials (40-45 min.)

PURPOSE: Apply the concept of matter to everyday needs.

PREREQUISITES: Exposure to the concept of raw materials.

ADVANCE PREPARATION: Materials - A sample of coal, and steel, a movie or study prints on steel-making and lumbermilling, a globe.

Language Cards/Key Sign
raw materials
coal
iron ore
the earth
steel
lumber
paper

TEACHING SUGGESTIONS:

1. If supplementary materials are available, begin with these. Show a short movie, pictures of the processes of making steel and producing lumber.

2. Ask the children to look at pages 40 and 41. Discuss each of the pictures.

3. Make a chart on the board. Use these labels:

Raw Material	Product

4. Have the children list the raw materials that they have been discussing (iron ore, coal, trees). Then have them list the things which are produced.

5. Make sure the children understand that all the matter that goes into the objects we use, live in, on and around, comes from the Earth. Our planet supplies all of our raw materials.

6. Using a globe of the Earth, explain that these raw materials come from all over the world, not only from the land, but also from the air and oceans.

7. Propose a problem to the children. Suppose all of the trees used for lumber were cut down. What would happen? Discuss this problem.

8. When the children begin to understand that our raw materials are limited, they can begin to become aware of what conservation means - making the best and wisest use of our raw materials and the products that are made from them.

LEARNING OUTCOME: Ability to identify some raw materials and discuss the need for their best and wisest use.

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EVALUATION: Lesson Cluster 1B-1 The Matter in Objects
Page T-86/S-42 Choose the Matter (20-25 min.)

PURPOSE: To evaluate performance in relation to the following objectives:

1. Examining objects and identifying some of the matter from which they are made.
2. Identifying and describing objects made of specific materials.

ADVANCE PREPARATION: Materials - student answer sheet
*In preparation for the first lesson of the next cluster, have the children put water in one beaker and place it in the freezer.

TEACHING SUGGESTIONS:

1. Have the children look over pages 42 and 43. Explain that they are to match up objects and the matter from which they are made.
2. Ask the children to write their answers on the student answer sheet.
3. After the children have given their answers, discuss the best choices of materials for each object with them.
4. If a child correctly makes most of the matches, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 3 Unit 1 Variation in Objects

Part B Variation in Matter, Lesson Cluster 1B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-92	Introduction	Changing Matter	35-40 min.
T-94	Development	Heat Changes the Phase	35-40 min.
T-98	Enrichment	Thermometers	35-40 min.
T-96	Development	Temperature and Change	35-40 min.
T-99	Application	A Burning Candle	25-30 min.
T-100	Evaluation	Find the Phase	15-20 min.

B. MATERIALS: See list on page T-89.

FILMSTRIP INFORMATION: Filmstrip Set VI, Variation, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1B-2 Phases of Matter
Page T-92/S-44 Changing Matter (35-40 min.)

PURPOSE: To introduce the concept of the phases of matter.

ADVANCE PREPARATION: Materials - three beakers
- a hot plate
- water

Language Cards/Key Signs
solid
liquid
gas
to change
What is happening?
phase
phases of matter
ice
water vapor

Identification Cards

TEACHING SUGGESTIONS:

1. Place the three beakers of water on a table in front of the class. One beaker contains water in the liquid phase, one the solid phase, and place one on a hot plate and heat the water.

2. Using the language cards for these three phases, ask the children to name the phase of the matter in each beaker. If the children have difficulty placing the cards, help them and then repeat the task again.

3. Ask the children to look at page 44. Guide the children in their discussion of water in the liquid and solid phases. Refer to the actual beakers as they are discussed.

4. Make sure the properties of water are described in each phase and constrasted between phases. When you have completed page 44, continue with page 45. Read the page to the children, asking them the questions, and initiating discussion.

5. Stress also that ice and water vapor are both still water. Ice and water vapor are simply special names for water in the solid and gaseous phases.

6. As you and the children use the term "phase" in context, the concept of its meaning will gradually be picked up.

7. Read the last paragraph on page 45 to the children. Write the terms: Phases of Matter, (and under that) solid, liquid, gas on the board or transparency. Discuss the fact that there are the three phases of matter. Have the children place the words: water, ice, water vapor, under the correct term.

8. Emphasize that water is used as an example of changes in phase, but that all materials change phase under certain conditions. We are familiar, however, with some materials in only one or two phases. Some materials are only gases, solids, or liquids, as we know them in everyday experience.

9. Ask the children for other examples of solids, liquids, and gases with which they come in contact. Copy these lists onto chart paper to display in the classroom.

DESIRED LEARNING OUTCOME: The children should be able to name and discuss the phases of matter.

* * *

DEVELOPMENT: Lesson Cluster 1B-2 Phases of Matter
Page T-94/S-46 Heat Changes the Phase (35-40 min.)

PURPOSE: To further develop the concept of the phases of matter.

PREREQUISITES: The ability to identify solids, liquids, and gases.

ADVANCE PREPARATION: Materials
- a tin can
- ice
- water
- an electric coffee pot, if available

Language Cards/Key Signs
to melt
butter
taken away
a freezer
to condense
drops of water

Identification Cards

TEACHING SUGGESTIONS:

1. Read and discuss pages 46 and 47 with the class. Develop each point carefully.

2. Emphasize that adding heat is necessary to change any solid (not just the examples shown) to a liquid or any liquid to a gas.

3. Emphasize that taking away heat (cooling) is necessary to bring about the reverse changes - that is, gas to a liquid, and liquid to a solid.

4. When you reach the last example on page 47 concerning water vapor, you may wish to do the following demonstration for the class.

5. Place a tin can on a sunny window sill or over a pot of boiling water. Fill the can with ice cubes and then pour water into the can. In time, water vapor from the air surrounding the can will condense on the outside of the can and become visible.

6. Ask the children, What has taken place? What has happened on the outside of the can? Why has some of the gas phase of water changed to the liquid phase?

DESIRED LEARNING OUTCOME: The children should be able to describe changes in phase in terms of heating or cooling of matter.

****

ENRICHMENT: Lesson Cluster 1B-2 Phases of Matter
Page T-98 Thermometers (35-40 min.)

PURPOSE: To develop skills using a Celsius thermometer.

PREREQUISITES: To read and interpret numbers on a number line.

ADVANCE PREPARATION: Materials
- 8-10 cups filled with varying temperatures of water
- Celsius thermometers for each child
- student worksheet
- large chart/transparency showing the numbers on the Celsius thermometer

Language Cards/Key Signs
thermometer
a Celsius thermometer
degree
temperature

Identification Cards

1. Number the cups and/or color the water with food coloring.

TEACHING SUGGESTIONS:

1. Place a chart/transparency on the board of the scale from a Celsius thermometer. Because a thermometer does not have a number for each mark, the children must be aware of how to count the marks to find the correct number of degrees.

2. Discuss with the children the appropriate method for finding the number. Point to different places on the scale and ask a child what that temperature would be. Continue this activity until you are certain that the children understand the concept.

3. Display the ten cups on a large table. Tell the children that they will find out something about the water in each cup. They will find out how hot or cold water is by using a thermometer.

4. Instruct the children that they are to place their thermometer in each cup, leaving the thermometer in the cup for one minute. Caution the children to be careful in handling the thermometers.

5. Point out to the children the proper way to read a thermometer containing a column of liquid. (The thermometer should be read at eye level - reading at an angle can cause distortion in interpreting markings on the scale.)

6. Then the children are to write the number of degrees of a particular cup in the appropriate space on the student worksheet.

7. When all of the children have taken the temperatures of all ten cups, begin to discuss the findings.

8. First ask the children, What do the high numbers mean?, What do the low numbers mean? (Hotter, colder.) Then tell the children that they are using a Celsius thermometer, and show them the proper way to write the temperature using the degree mark. Have the children check their worksheets, and change any temperatures written incorrectly.

9. Because the answers of each child will vary when comparing cups (as the hot water cools, etc.) do not do any comparison of temperatures of cups between the children. However, when the children are taking the temperatures of the water, walk among them and ask them questions about their readings, to make sure they are doing it properly.

DESIRED LEARNING OUTCOME: Ability to read a thermometer with ease.

* * *

DEVELOPMENT: Lesson Cluster 1B-2 Phases of Matter
Page T-96/S-48 Temperature and Change (35-40 min.)

PURPOSE: To expand the concept of phase to include temperature.

PREREQUISITES: To be able to read a Celsius thermometer, correctly.

ADVANCE PREPARATION: Materials - Celsius thermometers
- cups or tin cans enough for each child
- ice
- student worksheet

Language Cards/Key Signs
a thermometer
temperature
degrees
degrees Celsius
compare

Identification Cards

TEACHING SUGGESTIONS:

1. Ask the children to look at page 48. Read the text with the children, using the language cards where appropriate. Make references to the previous lesson, on reading the thermometer.

2. Explain that thermometers tell the relative temperatures of matter. Ask the children what the higher and lower numbers mean.

3. Go over the directions on page 49 with the children. Through discussion, have them answer the questions about the picture on that page.

4. Give each child a cup, ice, water and thermometer. Have the child set up and do the experiment as stated on page 49. Have each student write their answers on the student worksheet.

5. Discuss the results of the experiment with the class. Encourage the children to use the new vocabulary words.

DESIRED LEARNING OUTCOME: The children should be able to read thermometers.

****

APPLICATION: Lesson Cluster 1B-2 Phases of Matter
Page T-99/S-50 A Burning Candle (25-30 min.)

PURPOSE: To apply the concept of changes in phase to a candle.

PREREQUISITES: The ability to differentiate the phases of matter.

ADVANCE PREPARATION: Materials
- an untapered candle
- a candle holder
- matches
- a fire extinguisher or blanket should be nearby
- student worksheet
- (picture of the burning candle)

Language Cards/Key Signs
a candle
to burn
wax
an arrow

Identification Cards

TEACHING SUGGESTIONS:

1. Place the candle on a table. Light the candle. Have the children observe the candle.

2. Have the children look for evidence of the changes taking place as the candle burns. Ask them the question, Which phase is this? as you point to the candle, melted wax, and burning gas.

3. Ask the children to look at page 50 in their textbooks. Read the information with the children, using the language cards where appropriate.

4. Ask the children to look at the picture of the burning candle. Discuss the phases of matter present in the candle. Use the language cards for solid, liquid and gas or write the words on the board for review.

5. Ask the children to use the vocabulary to label the picture of the burning candle on their worksheet. Discuss their answers.

6. After the children have completed the worksheet, extinguish the candle. Again discuss the three phases of the wax. Also discuss how the burning match first releases enough heat to begin melting the wax and changing it to the gas phase. Then the liquid and gaseous wax ignites and releases enough heat to keep the combustion process going. It keeps doing this until it burns out or the fire is put out.

7. Be sure to emphasize how the changes occur, from solid to liquid to gas. Ask the children to explain these changes.

DESIRED LEARNING OUTCOME: The children should be able to observe and identify evidence of the three phases of wax in a burning candle and describe the changes taking place.

****

EVALUATION: Lesson Cluster 1B-2 Phases of Matter
Page T-100/S-51 Find the Phase (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:

1. Discussing and describing the conditions that bring about changes in phases of matter.
2. Inferring that heating changes solids to liquid and liquids to gases.

ADVANCE PREPARATION: Materials - student answer sheet

TEACHING SUGGESTIONS:

1. Have the children look at page 51. Ask the children to read the sentences.

2. Give each child a student answersheet. Ask the children to read the sentences again to themselves, and answer them. Tell the children to write their answers on their answer paper.

3. When all the children have completed theri responses, discuss their answers to the questions.

4. If a child correctly responds to most of the questions, you may assume that he/she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 3 Unit 1 Variation in Objects

Part C Variation in Interaction, Lesson Cluster 1C-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-106	Introduction	Interaction Systems	35-40 min.
T-108	Development	Repeating Systems	25-30 min.
T-110	Development	Similar Systems	25-30 min.
T-107	Enrichment	A Beanbag Contest	35-40 min.
T-112	Application	People and Systems	25-30 min.
T-114	Evaluation	Find the Systems	20-25 min.

B. MATERIALS: See list on page T-103.

FILMSTRIP INFORMATION: Filmstrip Set VI, Variation, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1C-1 Variation in Systems
Page T-106/S-53 Interaction Systems (35-40 min.)

PURPOSE: To reintroduce and define the concept of interaction systems.

PREREQUISITES: Exposure to the concept of interacting systems.

ADVANCE PREPARATION: Materials
- textbook
- wire - 25 cm
- batteries
- bulbs
- tape
- wire cutters (scissors) to clean off ends of wire

Language Cards/Key Signs
a dry cell (battery)
wire
a bulb
tape
interaction
a system
to touch

Identification Cards

TEACHING SUGGESTIONS:

1. Give each child a battery, bulb, wire, and tape. Ask the children to first name these objects (you can use the language cards for reinforcement) and then to put these objects together.

2. When each child has completed the 'system ' tell the children that this is called a system and that these objects are interacting together in that system. Be sure to use the language cards or write the words on the board.

3. Ask the children to open their books to page 53. Read the text with the children, using word cards where appropriate.

4. Read the last paragraph to the children. Have each child do the activity. Ask the children to explain what happened.

5. At the end of the lesson, again ask what the parts are of the system, and review the vocabulary covered in the lesson.

DESIRED LEARNING OUTCOME: Children should be able to name the objects of a simple interaction system.

****

DEVELOPMENT: Lesson Cluster 1C-1 Variation in Systems
Page T-108/S-54 Repeating Systems (25-30 min.)

PURPOSE: To further develop the concept of variation in systems.

PREREQUISITES: To understand the concept of repeating actions.

ADVANCE PREPARATION: Materials
- textbook
- materials from previous lesson
- a jump rope

Language Cards/Key Signs
to repeat
repeating systems
over and over again
variation

Identification Cards

TEACHING SUGGESTIONS:

1. Take one of the light systems. Touch the bulb to the battery repeatedly. Ask the children about what you are doing. Tell them that this is called a repeating system. Write the words on the board. Discuss the concept of repeating action.

2. Ask the children to look at page 54. Read the information to the children, emphasizing the fact that if a system does the same thing over and over again it is called a repeating system.

3. Ask the children to take their light systems and show how they can make it a repeating system.

4. Give one child a jump rope. Ask the child to make a repeating system with the rope. Discuss the actions of the child.

5. Have the children look at page 55. Relate their experience with the jump rope to the girl in the picture. Ask them to name the objects in that system.

6. Then ask the children to look at the picture of the boy. Have the children discuss what the boy is doing. Ask if they have ever had to do work such as this.

7. Discuss variation within these systems. Emphasize that neither of the two systems shows much variation.

DESIRED LEARNING OUTCOME: The children should be able to discuss the interaction expected in a repeating system, and to name the parts of those systems.

****

DEVELOPMENT: Lesson Cluster 1C-1 Variation in Systems
Page T-110/S-56 Similar Systems (25-30 min.)

PURPOSE: To further develop the concept of variation in systems.

ADVANCE PREPARATION: Materials
- one teaspoon flour
- one teaspoon sugar
- two saucers
- one bottle of tincture of iodine
- two glasses of half-filled milk
- one glass half-filled with vinegar
- one glass with lemon juice
- medicine dropper
- *If possible, have one set of these materials for each two students.

Language Cards/Key Signs
iodine
sugar
flour
milk
vinegar
lemon juice
alike
different

Identification Cards

TEACHING SUGGESTIONS:

1. Pass out the materials to the children. Have them open their textbooks to page 56. Tell them the children that they will be doing these experiments. Give the children instructions on how to perform the first experiment.

2. After the children have done the experiment and observed and discussed the results, read page 56 and answer the questions.

3. Now pass out the materials for the experiments on page 57. Explain the procedures to the children. Do one experiment at a time, discussing the results of the first before going on to the next.

4. Then have the children look in their books. Read the page with the children and discuss their answers to the questions.

5. Before you pour the pairs of systems together, have the children make predictions as to what kind of interactions they think will take place.

DESIRED LEARNING OUTCOME: The children should be able to compare interactions in systems and to make cautious predictions as to their outcome.

****

ENRICHMENT: Lesson Cluster 1C-1 Variation in Systems
Page T-107 A Bean Bag Contest (35-40 min.)

PURPOSE: To apply the concept of variation in systems to systems involving people.

PREREQUISITES: The ability to make a histogram and to follow rules of a game.

Language Cards/Key Signs
a bean bag
the limit mark
the goal mark
the player
a histogram (review)
a centimeter ruler
to take turns
range

Identification Cards

ADVANCE PREPARATION: Materials - bean bags
- tape
- centimeter rulers
- two histogram forms (transparency/board)
- playing area

Use masking tape to mark off a goal line on the floor. The line should be about 2 meters long, and a limit line about the same length. The lines should be parallel and spaced about 5 meters apart.

TEACHING SUGGESTIONS:

1. The bean bag contest is one of a number of suitable games that can be played in the classroom. Begin the game (as you should any of these lessons) by guiding the class in defining the system. As in defining any interaction system, only the essential parts need be included.

2. The Bean Bag System may be defined, for example, as the floor, the limit mark, the goal mark, the bean bag, and the player. Emphasize that each time the player is changed, a new although similar, system is formed.

3. Explain and demonstrate the rules of the game:
   A. The object of the game is to get the bean bag as near the line designated as the goal line as possible.
   B. The player must throw the bag so that is slides toward the goal line. (Somewhat like a bowling ball is thrown.)
   C. The player cannot step over the limit line. If the player does, a turn is lost.

4. When the children understand the rules, have them take turns trying their skill. Measure, to the nearest centimeter, the distance of the bag from the goal line each time. Have a couple of children help you and make a histogram on the chalkboard. When all have had a turn, note the least and greatest measurements (range).

5. Now choose one of the winners of the above game and have him or her throw the bag several times. Explain that he or she is to make the best possible throw each time. Measure and record each distance on a chalkboard histogram.

6. Conclude the lesson by discussing and comparing the range in the first histogram with the range in the second one. Remind the children that the first histogram shows variation of similar but different systems. The second histogram shows variation in a repeating interaction of the same system, because the player was not changed.

DESIRED LEARNING OUTCOME: The children should be able to discuss the expected differences in variation between similar and repeating systems.

****

APPLICATION: Lesson Cluster 1C-1 Variation in Systems
Page T-112/S-58 People and Systems (25-30 min.)

PURPOSE: To reinforce the concept of variation in systems to systems involving people.

PREREQUISITES: Beanbag Game (or other similar system).

ADVANCE PREPARATION: Materials - any available musical instruments, preferably a drum and a piano.

Language Cards/Key Signs
musical instruments
a drum
a piano (or other
  available instruments)
sound

Identification Cards

TEACHING SUGGESTIONS:

1. Show the musical instruments to the children. Have the children play the instruments. Find out which they can hear, which they cannot, and how loud it had to be.

2. Read page 58 to the children. Explain that musical instruments are systems involving people. Ask if the systems are repeating. Ask the children to show you a repeating system on their musical instrument.

3. Do not do page 59. This materials was covered in the game.

DESIRED LEARNING OUTCOME: The children should be able to discuss the role of people in causing variation in certain interaction systems.

* * *

EVALUATION: Lesson Cluster 1C-1 Variation in Systems
Page T-114/S-60 Find the Systems (20-25 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:
1. Identifying the objects that form a system.
2. Observing and discussing examples of interaction systems.

ADVANCE PREPARATION: Materials - student answer sheet.

Language Cards/Key Signs
a driver
a bumper car
a ferris wheel
people
a washer
a guitar
to strum
a pencil
string
a table
a hand
tape

Identification Cards

TEACHING SUGGESTIONS:

1. Place all of the language cards for this lesson in front of the children, or write the words on the board (in no particular order).

2. Discuss each picture with the children, asking which words go with each picture. Refer to the words on the board, but do not list the words to go with each picture.

3. Read the other questions with the children, to make sure that they understand what is required. To make answering easier construct the answer sheet so the child only has to circle the correct answers, or list items (except for 5 and 6).

4. Pass out the student answer paper and ask the children to read and answer the questions themselves.

5. When the children have finished writing their responses, discuss their answers with them.

6. If a child correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 3 Unit 1 Variation in Objects

Part C Variation in Interaction, Lesson Cluster 1C-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-120	Introduction	Galileo's Prediction	35-40 min.
T-122	Development	What is a Prediction?	20-30 min.
T-123	Development	How Sure Are You?	20-25 min.
T-124	Application	Using Predictions	20-25 min.
T-125	Evaluation	Making Predictions	20-25 min.

B. MATERIALS: See list on page T-117.

FILMSTRIP INFORMATION: Filmstrip Set XI, Variation, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1C-2 Predicting
Page T-120/S-62 Galileo's Prediction (35-40 min.)

PURPOSE: To introduce the process of predicting.

ADVANCE PREPARATION: Materials - For each pair of children have:
- two balls of different weights
- three books
- tape

Language Cards/Key Signs
prediction
a scientist
an idea
speed

Identification Cards

TEACHING SUGGESTIONS:

1. Have the children look at page 62 in the textbook. Explain the ideas of Galileo, using the language cards where appropriate. (All of the vocabulary from the story need not be included in the discussion.)

2. Point out that Galileo's belief that heavy and light objects would fall at the same speed was a prediction and not a guess, because it was based on observations and a lot of thought.

3. Now have the children set up and test one way to check out Galileo's prediction, as shown on page 63. (Use balls of the same size but of different weights.)

4. Explain that the children will have to watch the floor closely since the distance from the table top to the floor is short, and the results might not convince everyone. Several trials are essential, since it is critical that the balls leave the table at the same instant and it is difficult to observe them hit the floor.

5. Suggest that the children get down on the floor to watch more closely as the balls fall from the table. It is interesting that often children see what they expect to see in such experiments. In this case it is hard for some children to believe that the heavier ball does not fall faster and hit first.

DESIRED LEARNING OUTCOME: The children should be able to use the term prediction correctly in discussions.

****

DEVELOPMENT: Lesson Cluster 1C-2 Predicting
Page T-122/S-64 What is a Prediction? (20-30 min.)

PURPOSE: To continue development of the concept and process of prediction.

ADVANCE PREPARATION: Materials - pot with soil
- bean seeds

Language Cards/Key Signs
prediction
a guess

Identification Cards

TEACHING SUGGESTIONS:

1. Place the pot on a table. Fill it with soil. Place a bean seed in the pot. Ask the children what will happen. After they have responded, tell them that they were making predictions.

2. Have the children look at page 64. Read the text with the children explaining any concepts that they do not understand. Read and discuss the predictions under each picture.

3. Be sure the children realize that some predictions such as 'the sun is about to set' are more certain than others. The sun has never failed to set. On the other hand, sometimes bean seeds fail to grow, and even the best basketball players miss a basket once in a while.

4. During the discussion, be sure to differentiate between a prediction and a guess, and that a prediction is based on past experience.

5. At the conclusion of the lesson, ask the children to make predictions such as what their next class is, or what they will have for lunch.

DESIRED LEARNING OUTCOME: The children should be able to explain that predictions can be based on familiar past experiences.

****

DEVELOPMENT: Lesson Cluster 1C-2 Predicting
Page T-123/S-65 How Sure Are You? (20-25 min.)

PURPOSE: To further develop the concept and process of prediction.

ADVANCE PREPARATION:

TEACHING SUGGESTIONS:

1. Have the children study page 65. Read the text with the children. Discuss the predictions. Write the predictions on the board.

Language Cards/Key Signs
to be sure
pretty sure
explain

Identification Cards

2. Include in the discussion the information on which their predictions are based. Again refer to the difference between a guess and a prediction.

3. Note that the children's predictions can vary since the objects can interact in different ways.

4. Point out that the prediction one balloon is going to burst is pretty likely to occur.

5. Predictions will vary for how much of the building will crumble when struck. Such predictions are dependent upon the data available to the children on the subject.

DESIRED LEARNING OUTCOME: The children should be able to make predictions and discuss the probability that the predicted events will occur.

****

APPLICATION: Lesson Cluster 1C-2 Predicting
Page T-124/S-66 Using Predictions (20-25 min.)

PURPOSE: To apply the process of prediction to the decisions of daily life.

ADVANCE PREPARATION: Materials -

Language Cards/Key Signs
a stop light
to brush your teeth
a stove

Identification Cards

TEACHING SUGGESTIONS:

1. Have the children look at page 66. Read the text with the children, including the vocabulary connected with each picture.

2. Discuss the children's predictions for each situation. In the discussion, include a statement, prediction and basis for each prediction for each interaction.

3. Point out the importance of prediction in the decisions we make in our daily living. We constantly make predictions as we think about the things that we see and do.

4. As an additional activity, you may wish to have the children collect pictures illustrating the importance of prediction to the decisions made in daily living. Or, the children could write a short story on an experience that they had where prediction was necessary. All of these things could be displayed on a bulletin board.

DESIRED LEARNING OUTCOME: The children should be able to discuss the predictions behind every day decisions.

****

EVALUATION: Lesson Cluster 1C-2 Predicting
Page T-125/S-67 Making Predictions (20-25 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:
1. Describing and discussing the basis of given predictions.
2. Making predictions.
3. Discussing and judging the chances that predictions are correct.

ADVANCE PREPARATION: Materials - student answer papers

Language Cards/Key Signs
sand
a sand castle
a tennis raquet
clouds
a storm

Identification Cards

TEACHING SUGGESTIONS:

1. Have the children look at page 67. Look at each picture. Discuss the vocabulary within each picture.

2. Read and explain the text to the children. Ask them to write their predictions about the pictures on the student answer paper. If this is too difficult for the children, go to each child individually and ask for their answers.

3. When the children have completed their responses, discuss the possible predictions for each system (pictured) with them. Note that the predictions do not have to be identifical for each picture.

4. If a child correctly makes most of the responses, you may assume that he/she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 3 Unit 2 Space and Motion

Part A Space, Lesson Cluster 2A-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-136	Introduction	Exploring Space	35-40 min.
T-138	Development	Out in Space	30-35 min.
T-140	Development	Our Solar System	35-40 min.
T-144	Enrichment	Marbles and Space	35-40 min.
T-142	Development	A Space for Everything	15-20 min.
T-143	Application	A Place in Space	30-35 min.
T-145	Evaluation	Find the Space	15-20 min.

B. MATERIALS: See list on page T-133.

FILMSTRIP INFORMATION: Filmstrip Sets VII, Place and Motion, and XI, Motion and Changes, are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2A-1 Space Everywhere
Page T-136/S-70 Exploring Space (35-40 min.)

PURPOSE: To initiate development of the concept of space.

ADVANCE PREPARATION: Materials
- reference books
- children's books on space travel
- planets
- models of the solar system and/or pictures of the planets
- NASA will supply a teacher with a great deal of information on space, space travel and the solar system
- also have a globe available

Language Cards/Key Signs
space
the sun
the moon
the stars
to explore
air
a problem
a powerful machine
a rocket
the surface
gravity

Identification Cards

Background Information - Most children are fascinated by the subject of space beyond the Earth. Many will want to tell what they know - or think they know. Many of their ideas about space in terms of travel to other planets or other solar systems are, of course, inaccurate and quite fanciful. The influence of television and movie science fiction will be quite apparent. It is well to let the children express their ideas without too much concern at this time for separating fantasy from fact. Such separation is a gradual process that we can begin but not complete at this level. The ability of most children to grasp the idea of the vastness of space beyond the Earth, and the immense distances involves, will only be rudimentary. These concepts can only be introduced, not completely assimilated at this level.

1. A bulletin board display could be set up on space and our solar system.

TEACHING SUGGESTIONS:

1. This cluster could be introduced in two ways. One, a recent movie about space travel could be shown to the children. Or, you could take the children on an imaginary ride into space by telling them a story about space travel. These two things should be used to begin imaginative thought about the ideas of space travel and what is out beyond the earth.
2. Have the children look at page 70. Explain the information on this page, using the language cards as necessary. Discuss each of the points on this page with them.
3. Emphasize that the air gets thinner and thinner as one gets farther and farther above the Earth. All but one percent of the Earth's atmosphere lies around the Earth in a layer about 30 km thick. From about 320 km beyond Earth there is almost no matter in space except planets, stars, and solar dust.
4. Have the children look at page 71. Explain the information on this page. Discuss the problems that were faced in space exploration.
5. Explain to the children that there is a force holding us on the earth. Use a globe, and ask the children why people do not fall off the earth. Discuss the problems of space travel in relation to gravity.
6. Use as many additional materials as possible to help the children to be able to discuss space and space travel.

DESIRED LEARNING OUTCOME: The children should be able to discuss some aspects of space beyond the Earth.

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DEVELOPMENT: Lesson Cluster 2A-1 Space Everywhere
Page T-138/S-72 Out in Space (30-35 min.)

PURPOSE: To further develop the concept of space beyond the Earth.

ADVANCE PREPARATION: Materials - additional pictures
- models

Background Information - In photos of galaxies the stars look close together because of the great distances these stars are from the Earth. Within the universe there are countless galaxies and billions upon billions of stars.

Language Cards/Key Signs
a telescope
billions of stars
a galaxy

Identification Cards

TEACHING SUGGESTIONS:

1. Have the children look pages 72 and 73. Paraphrase the text on these pages, explaining the important details to the children.
2. Ask whether anyone can tell the rest of the class something about the telescope shown on page 72.

3. As you discuss these two pages with the children, make certain that they understand that the sun is a star much like the countless others that can be seen. You may need to explain to the children that the reason for the difference in appearance between the sun and other stars is that the sun is much closer to the Earth than any of the other stars. Therefore it appears brighter and larger.

4. You may wish to state again that the sun is a very great distance away from the Earth and that there are great distances between stars. Also, there are even greater distances between galaxies (groups of stars).

DESIRED LEARNING OUTCOME: The children should be able to briefly discuss some objects in space, specifically stars and galaxies.

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DEVELOPMENT: Lesson Cluster 2A-1 Space Everywhere
Page T-140/S-74 Our Solar System (35-40 min.)

PURPOSE: To further develop the concept of space beyond the Earth.

PREREQUISITES: Previous exposure to the idea of our being part of a solar system.

ADVANCE PREPARATION: Materials - model of our solar system and/or pictures of the planets
- (bulletin board display)

Language Cards/Key Signs
a planet
the solar system
an orbit
farthest
closest
(the names of the other planets)

Identification Cards

TEACHING SUGGESTIONS:

1. Show the children the model of the solar system. Have the children look in their books on page 74. Ask them to name each planet.

2. Explain the information on page 74 to the class. Ask questions to see if the children have any previous knowledge of the planets.

3. Have the children look at page 75. Explain the information to the children. Use photographs which you have obtained from NASA to supplement these practices.

4. Discuss the possibilities for life on the planets. As an additional activity, during language class have each child write a short story of what they think life would be like on one planet. Display the stories on the bulletin board about the solar system.

DESIRED LEARNING OUTCOME: The children should be able to briefly discuss the solar system, some of its members.

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ENRICHMENT: Lesson Cluster 2A-1 Space Everywhere
Page T-144 Marbles and Space (35-40 min.)

PURPOSE: To introduce the concept of the space occupied by objects.

ADVANCE PREPARATION: Materials - For each pair of students have:
- two cans of different sizes
- some marbles
- a tray
- a container filled with water
- one additional can

Language Cards/Key Signs
a marble
a tray

Identification Cards

TEACHING SUGGESTIONS:

1. Have two children working together. Pass out the materials.

2. Have the children fill the small can to the top with water. They then drop marbles gently into the can.

3. Discuss with each group what happened. Try to bring out the following ideas: marbles pushed water out of the can; there is only so much space in the can; everything takes up space; marbles took up space at the same time.

4. Have each group repeat the experiment with the larger can (fill to top with water, add marbles).

5. Now have each group take a can that has not been filled with water. Marbles are to be dropped gently into the can. Ideas to be brought out this time: what was in the can before the marbles were added? Many children will say "Nothing," but some will make the observation that the can was filled with air; something is being pushed out of the can (air); all objects take up space; two objects cannot occupy the same space at the same time.

DESIRED LEARNING OUTCOME: The children should be able to identify objects displaced by others and discuss what happened.

****

DEVELOPMENT: Lesson Cluster 2A-1 Space Everywhere
Page T-142/S-76 A Space for Everything

PURPOSE: To extend the concept of space to include the space occupied by objects.

ADVANCE PREPARATION: Materials
- a can
- a rock
- a tray
- a container of water
- textbook

Language Cards/Key Signs
a rock

Identification Cards

Background Information - In this lesson the word objects is used for any unit of matter: solid, liquid, or gas. Solids generally displace liquids and gases, liquids displace gases, and heavier gases displace lighter ones.

1. Place the can, rock and tray on a table in front of the class. Ask one child to fill the can to the top with water. Then tell the calss that you will put the rock into the water.

2. Discuss with the children what they think will happen. Relate it to their previous lesson with the marbles. Stress that all objects take up a certain amount of space and that only one object can be in a specific space at any one time. An object may push another object out of its space.

3. Place the rock in the water. Have the children observe what happened. Ask the children to explain why the water came out of the can.

DESIRED LEARNING OUTCOME: The children should be able to identify objects displaced by others and discuss what happened.

* * *

APPLICATION: Lesson Cluster 2A-1 Space Everywhere
Page T-143/S-77 A Place in Space (30-35 min.)

PURPOSE: To reinforce the concept that two objects cannot occupy the same time.

ADVANCE PREPARATION: Materials - two playground balls

Language Cards/Key Signs
a football player
a doorway
a basketball hoop
a basketball player

Identification Cards

TEACHING SUGGESTIONS:

1. Show the children the two playground balls. Place one ball on the floor. Have one of the children roll the other ball so that it hits the first ball. Ask the children what has happened and why.

2. After discussing the activity, have the children look at page 77. Discuss each picture, giving the appropriate vocabulary as needed. With each picture, ask a child to describe the situation and then to explain what has happened and why.

3. Some children may wish to volunteer further examples of objects competing for the same space. The children could draw pictures of these examples and display them on the bulletin board.

DESIRED LEARNING OUTCOME: The children should be able to identify objects displaced by others and discuss what happened.

* * *

EVALUATION: Lesson Cluster 2A-1 Space Everywhere
Page T-145/S-78 Find the Space (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:
1. Discussing space beyond the Earth and some of the objects to be found in it.
2. Stating that every object occupies space.

ADVANCE PREPARATION: Materials - student answersheet

TEACHING SUGGESTIONS:

1. Have the children look at page 78. Discuss each picture including the appropriate vocabulary. Write the words on the board/transparency. Pass out the answer papers.
2. Read the questions to the children one by one. Have them write their answers on the answer paper.
3. When the children have finished discuss each question with them.
4. If a child correctly responds to most of the questions, you may assume that he/she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

Language Cards/Key Signs

a rocket
a goldfish bowl
the Earth
a galaxy

Identification Cards

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Level 3 Unit 2 Space and Motion

Part A Space, Lesson Cluster 2A-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-150	Introduction	Closing in Space	35-40 min.
T-152	Development	Comparing Space	35-40 min.
T-154	Development	Measuring Volume	25-30 min.
T-155	Application	Find the Volumes	30-35 min.
T-156	Evaluation	Finding the Space Inside	15-20 min.

NOTE: Omit Rectangle forms (see Appendix C, page T-485).

B. MATERIALS: See list on page T-147.

FILMSTRIP INFORMATION: Filmstrip Sets VII, Place and Motion, and XI, Motion and Change, are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2A-2 The Space Inside
Page T-150/S-79 Closing in Space (35-40 min.)

PURPOSE: To begin development of the concept of volume.

ADVANCE PREPARATION: Materials - one copy of the cube form (Appendix B, page T-484) for each child
- scissors
- transparent tape
- a balloon
- a ball
- a bag
- a pencil
- a plant

Language Cards/Key Signs
space
hollow

Identification Cards

TEACHING SUGGESTIONS:

1. Pass out the Cube Form. (It is suggested that you use a variety of paper colors if available.) Have the children make the cube. Tell them that they will be making a box, but then let them discover how to put the box together, on their own.

2. After the children have completed their cubes, ask them to explain how they put them together. Ask them what is inside the cube.

3. Have the children look at page 79. Discuss the information with the children.* Ask them to give other examples of things that take up space. Discuss the cube again. Explain that the paper in the cube takes up space and encloses a certain amount of space.
   *Stress that space is everywhere.

4. Place the other objects (listed in materials) on a table. Ask the children which objects are hollow like the box. Make a list of these objects on the board. Then list those objects in the group that are not hollow. Stress that all of these objects take up space. Air fills many spaces that appear to be empty. The form of the object closes in space.

DESIRED LEARNING OUTCOME: The children should be able to discuss and describe objects in terms of their shapes and the space inside.

****

DEVELOPMENT: Lesson Cluster 2A-2 The Space Inside
Page T-152/S-80 Comparing Space (35-40 min.)

PURPOSE: To continue development of the concept of volume and begin the comparison of volumes.

ADVANCE PREPARATION: Materials
- textbook
- a variety of cans and boxes
- play sand
- a tray for each pair of children
- a student worksheet
- marbles

Language Cards/Key Signs
volume

Identification Cards

1. Have the students number their containers.

TEACHING SUGGESTIONS:

1. Pass out the materials to each pair of children and tell the children that they will be comparing the containers. Have the children choose two containers to compare.

2. Ask the children which they think will hole more sand. Have them put the information on the student worksheet, which should look like the following:

Which container will hold MORE?

Prediction Test

3. Then have the children try and find out which container holds more sand. Instruct them to write the number of the container that holds more on their paper. Ask if their prediction was correct. Have them test a few more pairs of containers. Circulate among the children to see that they are experiencing no difficulties.

4. When the children have completed this, have them open to page 80. Discuss the pictures and the questions with the children, relating them to what they did previously. Tell the children that the amount of space inside a container is called its volume. Write the word on the chalkboard.

5. Have the children look at page 81. Discuss the page with them. Make sure they understand how marbles were used to compare volumes. Tell the children the volume of a container can be given a number. One way to do this is to count the number of objects it takes to fill up the space. Emphasize that marbles used for such a purpose should be of the same size, so that each marble takes up the same space.

6. Have various children find the volumes of each of several containers in terms of the number of marbles they will hold.

7. Have them fill the containers a second time to find out if they get nearly the same number.

8. Have the children mark the number of marbles on each container and then line up the containers in order of volume from smallest to largest.

DESIRED LEARNING OUTCOME: The children should be able to compare the volumes of different containers.

****

DEVELOPMENT: Lesson Cluster 2A-2 The Space Inside
Page T-154/S-82 Measuring Volume (25-30 min.)

PURPOSE: To measure volume by using a standard unit of measure.

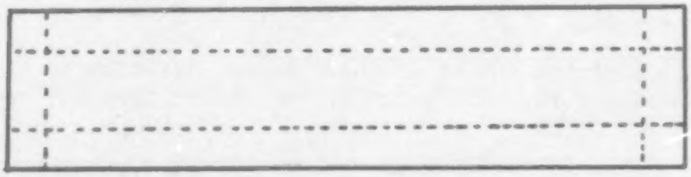
PREREQUISITES: The ability to count objects and use standard units of measurement.

ADVANCE PREPARATION: Materials - centimeter cubes
- rectangle forms (Appendix C, page T-485) modified
- student answersheet

Language Cards/Key Signs
a cubic centimeter
volume
a shape

Identification Cards

1. Take the rectangle sheet and construct the rectangles so that they have sides measuring one centimeter.



TEACHING SUGGESTIONS:

1. Pass out the 'boxes' to the children. Show them the cubic centimeters. Ask them to find the volume of each box using the centimeter cubes.

2. Have the children write their answers on the student answersheet. Pass the boxes around so each child has a chance of measuring each box.

3. When all of the children have completed their measurements, compare and discuss their answers.

4. Ask the children to look at page 82. Explain to them that the blocks they were using are called cubic centimeters. Show the children that when they record their answers, they should write the number, and then write 'cubic centimeters'. Have the children add these words to their answers on the answersheet.

5. Ask the children to find the volume of the three shapes at the bottom of the page. Tell them to write their answers on their answer paper. Emphasize that they should use 'cubic centimeters'.

6. Discuss the children's answers. If any children have made mistakes on this part, make some other shapes with the cubic centimeters and ask the children to tell you the volume.

DESIRED LEARNING OUTCOME: The children should be able to measure volume by using a standard unit of measure - the cubic centimeter.

****

APPLICATION: Lesson Cluster 2A-2 The Space Inside
Page T-155/S-83 Find the Volumes (30-35 min.)

PURPOSE: To find the volumes in cubic centimeters of several rectangular shapes.

ADVANCE PREPARATION: Materials - centimeter cubes
- student answersheet

1. Make up the shapes as shown on page 83.

Language Cards/Key Signs
volume
shapes
cubic centimeters

Identification Cards

TEACHING SUGGESTIONS:

1. Place the shapes (from page 83) on a table. Have the children sit around the table. Ask them to look at the shapes. Have the children tell you the volume of each shape.

2. Ask the children to look at page 83. Ask them to find the volume of each shape and write it on their answersheet. Remind them to use 'cubic centimeters' when writing their answers. (They should also be using this when giving answers orally.)

3. Again have the children look at the shapes you have made. Ask them if two different shapes can have the same volume. Ask which of the shapes have the same volume (a/c, d/e).

4. Ask the children how the shapes that have the same volume are different. They will see that the number of rows is different - one shape has two rows instead of one.

5. Ask the children to work in pairs. Give each pair 36 cubes. Ask them to make three different shapes with the volume of 12 cc. Discuss the results of their efforts.

DESIRED LEARNING OUTCOME: The children should be able to use cubic centimeters to find the volumes of a number of different rectangular shapes.

****

EVALUATION: Lesson Cluster 2A-2 The Space Inside
Page T-156/S-84 Find the Space Inside (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:
1. Discussing and describing shapes that have the same volume.
2. Identifying which of several shapes has the largest volume.

ADVANCE PREPARATION: Materials - student answersheet

Language Cards/Key Signs
largest

Identification Cards

TEACHING SUGGESTIONS:

1. Ask the children to look at page 84. Pass out the student answersheets.
2. Read each question to the children. Have them write their answers on the answersheet.
3. After the children have finished, discuss each question with them.
4. If a child correctly responds to most of the questions, you can assume that he/she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 3 Unit 2 Space and Motion

Part B Position, Lesson Cluster 2B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-162	Introduction	Lost and Found	35-40 min.
T-164	Development	Direction	35-40 min.
T-166	Development	Distance	35-40 min.
T-168	Enrichment	Game: Find the Object	35-40 min.
T-169	Application	Describing Positions	35-40 min.
T-170	Evaluation	Find It!	20-25 min.

B. MATERIALS: See list on page T-159.

FILMSTRIP INFORMATION: Filmstrip Sets VII. Place and Motion and XI Motion and Change are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2B-1 A Place in Space
Page T-162/S-86 Lost and Found (35-40 min.)

PURPOSE: To introduce the concept of position and its description.

BACKGROUND INFORMATION: The positions of objects are always relative. The position of one object alone in "empty" space could not be described because there would be nothing to use as a reference object. Since children are naturally egocentric, they tend to observe and "sense" positions relative to themselves. Frequently, this use of one's self as the reference object is satisfactory for everyday purposes. Most scientific descriptions, however, are stated in a specific and permanent manner.

ADVANCE PREPARATION - Materials: Ojbects in the room.

TEACHING SUGGESTIONS:

1. Without telling the children, choose an object in the room as a reference object. Say a few statements to the class about other objects in reference to one object. Ask the children to join in, using the same reference object.

Language Cards/Key Signs
lost
found
a fisherman
a two-way radio
position
reference object

2. Then choose another reference object (again not telling the children) and begin the sentences again. Ask the children to join into the game.

3. Then write the words reference object on the board/transparency. List the things which were used as reference objects during the game.

4. Have the children look at page 86. Tell them the story, using the language cards to reinforce new vocabulary. Ask the children, Did the fisherman have

have reference objects? Ask them to explain how the men were found. As you discuss why the fisherman can't describe their position, point out that no other objects were visible. Explain that the position of an object cannot be described unless there is at least one other object tc use for reference.

5. Have the children look at page 87. Tell the story to the children. As you discuss the story, contrast Carlos' situation with that of the fishermen. Ask the children, Do you think Carlos' mother found him? Why or why not? What did Carlos' have that the fishermen did not have? If you were lost in the city, how would you give directions for someone to find you?

6. Ask the children what the reference objects were for Carlos. List them with the other objects (from beginning of lesson) on board.

DESIRED LEARNING OUTCOME: The children should be able to describe the positions of objects relative to a designated reference object.

****

DEVELOPMENT: Lesson Cluster 2B-1 A Place In Space
Page T-164/S-88 Direction (35-40 min.)

PURPOSE: To continue development by the concept of positive and its description by emphasis on direction.

PREREQUISITES: Previous experience with the words of direction, and a knowledge of right and left.

ADVANCE PREPARATION: Materials - objects in the classroom for use as reference objects

Language Cards/Key Signs
direction
in front of
behind
above
under
right
left
reference object

TEACHING SUGGESTIONS:

1. Demonstrate the six principal directions in space relative to an object. In one hand hold some object, such as a toy airplane, that has a distinct front, as this is the reference object. In the other hand hold another object. Have the children name each of the six positions (front, behind, above, below, right, left) as you illustrate them.

2. Write the vocabulary words on the board (or use the language cards), while using the words in discussion. Explain that these words are often used to tell the direction of an object from a reference point. Print the word direction on the board as a title over the other words.

3. Have the children look at page 88. Read the text to them, asking questions as they are stated. Emphasize that to have meaning direction must always be from some reference object.

4. Now ask the children to look at page 89. Read the text with them, again asking questions as they appear. If there is any confusion among the children, ask for three volunteers and have them stand in front of the room. Ask the same questions about the children that were asked in the book.

5. Using objects with distinct fronts as reference objects in the classroom, describe the locations of other objects in the room. Do this until the use of direction and reference objects becomes clear to the children.

LEARNING OUTCOME: The children should be able to locate and describe the positions of objects in terms of direction from a reference object.

* * *

DEVELOPMENT: Lesson Cluster 2B-1 A Place in Space
Page T-166/S-90 Distance (35-40 min.)

PURPOSE: To further develop the concept of position and its description by emphasis on distance.

BACKGROUND INFORMATION: Previous activities have stressed the use of qualitative direction terms in describing position. Such descriptions are sufficient only in simple situations. In this activity the children solve the problem of how to designate a specific object when more than one object is in the same direction.

PREREQUISITES: Previous experience with the words of distance.

ADVANCE PREPARATION: Materials - objects to use as reference objects

Language Cards/Key Sign
distance
far
near
very far
very near

TEACHING SUGGESTIONS:

1. Set up an arrangement of several objects around a reference object. Place two objects in a straight line in one direction - one near the reference object. Place two objects in a straight line in one direction - one near the reference object and the other farther away. Call on children to describe the positions of the objects as you name them. When the problem of the two objects in the same direction arises, let the children suggest ways to distinguish between their locations.

2. Write suggested terms on the chalkboard, building the children as necessary to list far, near, very far, and very near.

3. Now have the children look at pages 90 and 91. Read the text to the children, explaining as you go through the information. Discuss the concept of distance. Point out that the girl is the reference object in the other picture.

4. If there are children in class who still seem to have difficulty in using distance and direction from a reference object, make another room arrangement around a reference object. Work with those children that need help in using locator words.

LEARNING OUTCOME: The children should be able to locate and describe objects on the basis of their distance and direction from a reference object.

* * *

ENRICHMENT: Lesson Cluster 2B-1 A Place in Space
Page T-168 Game: Find the Object (35-40 min.)

PURPOSE: To provide further practice in describing and locating relative positions. This lesson does not appear in the student text.

ADVANCE PREPARATION: Materials - objects in the classroom

TEACHING SUGGESTIONS:

1. List all of the vocabulary words used for direction and distance on the board.

2. One child is chosen to begin the game. This child secretly selects any object visible to the children in the classroom (or through the windows, if available). The child states a reference object to be used, and then describes the position of the mystery object in relation to the reference object.

3. The children who think they know the object raise their hands. Members of the class are called on until the mystery object is identified. The person correctly identifying the mystery object then becomes "it" and chooses another mystery object for the class to identify.

4. You probably will find it necessary to referee from time to time, and you may wish to have the person who is "it" whisper the name of the mystery object to you.

LEARNING OUTCOME: The children should be able to locate and describe objects on the basis of their direction and distance from a referance object.

****

APPLICATION: Lesson Cluster 2B-1 A Place in Space
Page T-169/S-92 Describing Positions (35-40 min.)

PURPOSE: To apply the concept of position and its description to realistic situations.

ADVANCE PREPARATION: Materials -

1. Locate a few places to visit in the school which have an arrangement of objects that are easily described using the direction/distance vocabulary in the previous lessons.

Language Cards/Key Sign
an artist
(other objects found
in the school)

TEACHING SUGGESTIONS:

1. Take a walk through your school. Stop at the places which you have found previously (fitting the above characteristics). Ask the children to explain the position of objects in relation to the reference object which you have stated.

2. In the second situation, have a child choose the reference object, and then describe an object in relation to that. Continue this activity through several other situations.

3. Have the children look at page 92. Read the text to them, and discuss what it says. Ask them to give the statements describing positions of objects in the picture.

4. Challenge the children to figure out a way to describe their own positions in the classroom. Explain that the description must be such that a stranger could locate them.

5. For further reinforcement of these concepts, have the children (during a language lesson) explain their position in the classroom and write it on paper. These could be displayed on a bulletin board.

DESIRED LEARNING OUTCOME: The children should be able to locate and describe positions relative to stand reference objects.

****

EVALUATION: Lesson Cluster 2B-1 A Place in Space
Page T-170/S-93 Find It! (20-25 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:

1. Describing positions in terms of relative distance and direction from a reference object.
2. Locating and identifying objects on the basis of descriptions of positions.

ADVANCE PREPARATION: Materials - student answer sheet

Language Cards/Key Sign
a sailboat
a cloud
a rowboat
land

TEACHING SUGGESTIONS:

1. Have the children look at the picture on page 93. Have them name the objects in the picture. Write the names on the board.

2. Pass out the student answer sheets. Read the questions to the children, and have them write their answers on the answer sheet.

3. After the children have completed their answers, discuss them.

4. If a child correctly responds to most of the questions you may assume that he or she has demonstrated the objective for the cluster and is ready to go on to the next cluster.

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Level 3 Unit 2 Space and Motion

Part B Position, Lesson Cluster 2B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-176	Introduction	Place and Position	35-40 min.
T-178	Development	Position Picture	20-25 min.
T-179	Development	A Position Game	35-40 min.
T-182	Application	Your Own Position Finder (construction only)	35-40 min.
T-180	Development	Clock Direction Finder	30-35 min.
T-181	Development	Clock Position Finder	30-35 min.
T-182	Application	Your Own ...(textbook)	20-30 min.
T-183	Evaluation	Find the Positions	15-20 min.

B. MATERIALS: See list on page T-173. Also make the following adjustments -
- change yarn to seam binding
- omit meter stick

INTRODUCTION: Lesson Cluster 2B-2 Position Finders
Page T-176/S-94 Place and Position (35-40 min.)

PURPOSE: To introduce the children to simple position finders.

PREREQUISITES: Using a number line, counting, directions of up/across.

ADVANCE PREPARATION: Materials - Position Finder Forms (Appendix D, page T-486)
- red, green, blue, yellow, orange marking pens
- pencils or crayons
- transparencies of the grids on page 94 and 95

Language Cards/Key Signs
place
position
a circle
a square
a triangle
a star
across
a position finder

Identification Cards

TEACHING SUGGESTIONS:

Note: The textbook will not be used until the end of the lesson where mentioned.

1. Show the children the first transparency (page 94). Explain that the number line can be drawn on paper to form systems that make it easier to locate any position in the system. Such systems are useful in making records of positions.

2. Discuss the number line and figures from page 94. Guide the children to notice that this number line and the position of the figures is not clear. See if they can develop a better way of writing it.

3. Then show the children the grid on page 95. (This can be an overlay for the first transparency.) Again ask the positions of the figures on the grid.

4. When the children have finished page 95, review the rectangular system with them. Draw a rectangular system on the board (or use a transparency) and demonstrate how to count across and up to locate and mark positions. Draw other shapes on the rectangular system, and ask the children for their positions.

5. Pass out the blank Position Finder Forms, one to each child. Also pass out the colored pens or crayons. Ask each child to make five circles on the rectangular system, one of each color.

6. When the children have completed the circles, have them exchange papers, and fill in the bottom portion of the worksheet. Discuss their answers as a group.

7. As an additional activity, you could fill in various circles on the rectangular system, and give one paper to each child. This could be done at a later time or for homework.

DESIRED LEARNING OUTCOME: The children should be able to locate objects with position finders.

****

DEVELOPMENT: Lesson Cluster 2B-2 Position Finders
Page T-178/S-96 Position Picture (20-25 min.)

PURPOSE: To continue development of the concept of finding position.

ADVANCE PREPARATION: Materials - a transparency of the clown picture*

*If it is not possible to make a transparency, cut out a picture from a magazine, or use a poster over which you have drawn the rectangular system.

Language Cards/Key Signs
a clown

Identification Cards

TEACHING SUGGESTIONS:

1. Put a transparency of the clown picture on the board. Have the children look at page 96. Read the text with the children. Have them answer the questions.

2. Some children may be confused as to which of the clown's eyes is the right one. Point out that the reference object is the clown, and it is the clown's eye that we are asked to find the position of.

3. Some children may wish to know if positions can be located by calling out the up number first and then the across number. Point out that it doesn't matter which comes first as long as the direction across or up is identified.

4. You may wish to draw a grid on the chalkboard on which you draw a funny face for additional practice in finding parts.

DESIRED LEARNING OUTCOME: Children should be able to make use of simple position finders.

* * *

DEVELOPMENT: Lesson Cluster 2B-2 Position Finders
Page T-179/S-97 A Position Game (35-40 min.)

PURPOSE: To further develop the concept of finding position.

PREREQUISITES: Reading numbers from dice.

ADVANCE PREPARATION: Materials - Position Game Forms (Appendix E, page T-487)**
- a cup and dice (for each pair of players)
- markers

**This form should be modified. The numbers on the rectangular system should be make larger and more prominent.

Language Cards/Key Signs
dice
a marker
a partner
a straight row
the winner

Identification Cards

TEACHING SUGGESTIONS:

1. Have the children look at page 97. Explain the rules of the game to them. Demonstrate what a straight row looks like - give several examples.
2. Ask the children to pick a partner. Pass out a game form and markers to each child, and a cup and dice to each pair.
3. Players take turns throwing a pair of dice and marking the position indicated by the numbers that turn up. A player chooses the number on either die for "across" and the number on the other die for "up."
4. A marker is placed on that position.
5. The player who gets four markers in any straight row first wins the game. The markers do not have to be in four consecutive positions. All that is required is that a straight line can be drawn through the four markers.
6. Emphasize that the number on either of the dice can be chosen for "across", but that the other must be used for "up." If children are alert, this factor may help them to get "four-straight" sooner.

DESIRED LEARNING OUTCOME: The children should be able to locate and mark specified positions on simple rectangular position systems.

* * *

APPLICATION: Lesson Cluster 2B-2 Position Finders
Page T-182/S-100 Your Own Position Finder (35-40 min.)

PURPOSE: To develop a clock position finder for use in finding direction and distance in pictures or with real objects.

ADVANCE PREPARATION: Materials - art paper
- a clock face (Appendix F, page T-488)
- seam binding marked off in centimeters
- paper clips
- glue
- small objects

Language Cards/Key Signs
a clock face
a fastener
seam binding
a position finder

Identification Cards

1. Make up one position finder before the lesson.

TEACHING SUGGESTIONS:

Note: At this point, the children will make the position finder. This will be used in the next two lessons. However, the textbook page will not be used until after the two lessons.

1. Show the children the position finder which you have made. Tell them that they will make one and that it will be used to find the positions of objects.

2. Give each child the necessary materials, telling them the names for the materials as they are passed out.

3. Have each child mount the clock face on the art paper with glue. You will need to punch a hole at the center of each clock face with a paper clip (or other object) so that the brass fastener can be placed there. Before putting the fastener through the cardboard, the child should put the seam binding onto the brass fastener.

DESIRED LEARNING OUTCOME: The child should successfully construct a position finder.
****

DEVELOPMENT: Lesson Cluster 2B-2 Position Finders
Page T-180/S-98 Clock Direction Finder (30-35 min.)

PURPOSE: To continue development of position finder and their use.

ADVANCE PREPARATION: Materials - clock position finders (made in previous lesson)
- a large sheet of paper on which you have drawn the pictures for each student from page 98*

*The pictures should be drawn in such a way that the children can place their position finder in a specified place, and have the objects be in the same positions as on pages 98 and 99.

Language Cards/Key Signs
a clock
an hour
the center
the direction

Identification Cards

TEACHING SUGGESTIONS:

1. Have the children place their clock direction finder on their large sheet of paper, so that it corresponds to the picture on page 98.

2. Have the children look at page 98. Discuss the page with them. Explain the system of finding object positions in relation to the hours of the clock. Emphasize that the reference point is the center of the clock. Directions are indicated by lines from the center of the clock and identified by the appropriate reference number.

3. Ask about the positions of the objects pictures on page 98. Have the children place their seam binding on the object and tell the position of the clock.

4. You may wish to pose the following problem to your class. Take one of the children's large sheets of paer and tape it to the blackboard. Place one additional object on the picture half way between two hours. Ask the children how they would identify the position of that object.

DESIRED LEARNING OUTCOME: The children should be able to use a clock system for finding direction.

****

DEVELOPMENT: Lesson Cluster 2B-2 Position Finders
Page T-181/S-99 Clock Position Finder (30-35 min.)

PURPOSE: To use a clock position finder to find both direction and distance.

ADVANCE PREPARATION: Materials - position finders (made previously)
- large sheets with pictures of objects (made previously)
- additional pictures of objects to place on the large picture

Language Cards/Key Signs
direction
distance
a centimeter

Identification Cards

TEACHING SUGGESTIONS:

1. Draw the clock and objects from page 99 on the board. Have the children use their position finders and the large sheets with the pictures as in the previous lesson.

2. Have the children look at page 99. Read the text with the children. Explain that the tape, marked off in centimeters, can now be used to measure distance as well as tell direction. Point out that distance from a reference point to an object is generally measured to the center of the object to be located.

3. Place a few additional pictures on the large picture on the blackboard. Ask the children to tell you the position of each of these objects.

DESIRED LEARNING OUTCOME: The children should be able to use a clock position finder to find both direction and distance.

****

APPLICATION: Lesson Cluster 2B-2 Position Finders
Page T-182/S-100 Your Own Position Finder (20-30 min.)

PURPOSE: To use a position finder to find direction and distance.

ADVANCE PREPARATION: Materials - clock position finder
- a variety of small objects
- student worksheet

Language Cards/Key Signs
names of objects used

Identification Cards

TEACHING SUGGESTIONS:

1. Set up five or six areas around the room where real objects are arranged. Specify where the children are to place their position finders in these areas. Have the objects taped to the floor or table, so they cannot be moved by the children. The areas could be labeled, A, B, etc.

2. Tell the children that they will be finding the position of different objects. Explain that there are different areas around the room. They are to go to each area, place their position finder in the appropriate spot, and find the direction and distance for each of the objects.

3. For vocabulary work, either go around to each area and have the children name the objects, and label them, or have them labeled before the lesson begins.

4. Pass out an answer paper to each child. The paper should be headed as follows:

	Direction	Distance
1.		
2. etc.		

5. Ask the children to go to each area and make their recordings. When they have completed their work, compare the results, and discuss them.

DESIRED LEARNING OUTCOME: The children should be able to use a simple position finder to determine and record the position of objects.

* * *

EVALUATION: Lesson Cluster 2B-2 Position Finders
Page T-183/S-101 Find the Positions (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:
1. Using linear measurement to determine position.
2. Using a rectangular position finder to determine position.
3. Using a clock position finder to determine direction and distance.

ADVANCE PREPARATION: Materials - student answersheet

Language Cards/Key Signs
name of objects in the pictures if necessary

Identification Cards

TEACHING SUGGESTIONS:

1. Have the children look at page 101. Have the children look at each object on the page and name them. Write the names on the board.

2. Pass out the student answersheet. Ask the children to read the questions themselves and write their answers on the paper.

3. After the children have completed their work, discuss all of their answers.

4. If a child correctly responds to most of the questions, you may assume that he/she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

* * *

NOTE: Cluster 2B-3 has been omitted.

Level 3 Unit 2 Space and Motion

Part C Motion, Lesson Cluster 2C-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-202	Introduction	What is Motion?	35-40 min.
T-204	Development	Steps in Motion	25-30 min.
T-206	Application	Making Flip Books	35-40 min.
T-208	Evaluation	Look for Motion	15-20 min.

B. MATERIALS: See list on page T-199. Also make the following adjustments -
- omit round hat box
- omit Flip Book Picture Blank Form Appendix H, page T-490

FILMSTRIP INFORMATION: Filmstrip Sets XII, Place and Motion, and XI, Motion and Change, are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2C-1 Investigating Motion
Page T-202/S-110 What is Motion? (35-40 min.)

PURPOSE: To introduce the concept of relative motion.

ADVANCE PREPARATION: Materials - a toy car
- a toy tree
- textbook
- colored paper
- poster board

Language Cards/Key Signs
motion
changing position
reference object
a skier
a slide

Identification Cards

TEACHING SUGGESTIONS:

1. Set up the car and tree on a desk. Place the desk up next to the blackboard. Place a piece of colored paper behind the desk to make a background for the objects. Also have a piece of poster board which you can put in front of the desk when changing the objects.

2. Ask the children to notice the position of the car. Place the poster board in front of the desk and move the car. Then ask the children about the position of the car. Do this one more time but do not move the car. Again ask for information from the children.

3. Have the children look at page 110. Write the word motion on the board. Discuss what it means. Have the children look at the pictures on page 110 and discuss what is happening in each picture.

4. Have the children look at page 11. Read the text to the children. Discuss each set of pictures, including the essential vocabulary. Write these words on the board, or use the language cards. Ask the children about the objects in the pictures.

5. Put this chart on the board:

Moving Object	Reference Object

Have the children look again at each of the four pictures. Ask them to list the object in each picture that was moving and the object that was used as a reference object.

DESIRED LEARNING OUTCOME: The children should be able to describe motion relative to reference objects.

****

DEVELOPMENT: Lesson Cluster 2C-1 Investigating Motion
Page T-204/S-112 Steps in Motion (25-30 min.)

PURPOSE: To continue developing the concept of relative motion and its description.

PREREQUISITES: The ability to sequence pictures showing action.

ADVANCE PREPARATION: Materials - pictures showing movement of objects*
- textbook

*If possible, either take photographs of moving objects, or objects that you have moved into different positions, or draw such pictures, four pictures to a set, three or four sets.

Background Information - Change in the position of an object is evidence that motion has occurred. The beginning and end positions are part of the description of the motion. What happened to the object between these two positions is part of the description also. The children consider this question by examining pictures of objects in intermediate positions in a motion sequence.

Language Cards/Key Signs
Which picture is missing?
a row of pictures
a fence
a sailboat
a building

Identification Cards

TEACHING SUGGESTIONS:

1. Take one of the sets of pictures which you have done. Mix the pictures up and tape them to the blackboard. (They should be large enough to be clearly visible to the class.)

2. Explain to the children that these pictures show an object in motion. Ask one of the children to come up to the board and put the pictures in the correct order. Ask the other children if the ordering is correct. Discuss the motion and the reference object.

3. Put the next set of pictures on the board, keeping one picture out of the sequence. Have one child put the pictures there in sequence. Explain to the children that one picture has been left out. Show them the picture and have one child place it in the correct position.

4. Do one or two sets of pictures like this. If possible, have one picture in the last set that does not belong at all. See if the children can explain why this picture does not fit.

5. Ask the children to look at page 112. Again discuss the sequencing idea with these pictures. Have the children pick the picture that they think fits the sequence. Ask for their reasons why the picture fits. Ask what the moving object and reference object are.

6. Have the children look at page 113. Do the same as with the previous page. Discuss their answers. Ask the children to tell you what helps them to tell how far the sailboat has moved in each photograph and what reference object was used.

DESIRED LEARNING OUTCOME: The children should be able to identify and discuss motion relative to reference objects.

****

APPLICATION: Lesson Cluster 2C-1 Investigating Motion
Page T-206/S-114 Making Flip Books (35-40 min.)

PURPOSE: To apply the concept of relative motion by using change in position to create the illusion of motion.

PREREQUISITES: Placing pictures in order according to position of objects.

ADVANCE PREPARATION: Materials
- 19 pieces of white construction paper - 100 mm x 77
- a ditto with a sequence of pictures (to be made into a flip book)
- staplers
- colored pencils or crayons
- glue

Language Cards/Key Signs
a flip book
to staple
to flip smoothly

Identification Cards

Background Information - Flip books provide excellent manipulative experience with the basic principles of relative motion. Flip books clearly illustrate change in position, reference objects, and path traveled. These books are particularly interesting to children because the illusion of motion is created in the same basic manner as in movies.

TEACHING SUGGESTIONS:

1. Begin the lesson by having the children look at page 114. Explain that they will be making some flip books that show motion of one object, using another object as the reference object.

2. Pass out the ditto on which you have drawn a sequence of pictures (the flower and butterfly from page 114 would be good). Tell the children to cut out the squares and glue them onto the white paper. Have the children put the pictures in order one end to make the book.

3. Ask the children to flip the pages smoothly and look at what happens to the objects. Ask them which is the moving object and which is the reference object.

4. Have the children look at page 115. Discuss the sequence of the pictures and answer the questions.

5. Then instruct the children to take the other nine piece of paper and to draw their own flip book pictures. Tell them to make sure one object does not move, while the other object moves with slight changes in position.

6. After the children have completed their flip books, have them pass the books to other children to try out. Discuss their books. Ask them to explain why we see the objects as moving.

DESIRED LEARNING OUTCOME: Children should be able to make flip books and discuss the illusion of motion they create.

****

EVALUATION: Lesson Cluster 2C-1 Investigating Motion
Page T-208/S-116 Look for Motion (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:
1. Inferring motion from change in relative position.
2. Describing motion relative to reference objects.

ADVANCE PREPARATION: Materials - student answersheet

Language Cards/Key Signs
a school bus
a swing
a net

Identification Cards

TEACHING SUGGESTIONS:

1. Have the children look at the pictures on page 116. Discuss each picture and list all of the vocabulary words from the pictures on the board.

2. Pass out the students answersheet. It should look like this:

	Moving Object	Reference Object
A		
B		
C		

3. Have the children look at the pictures and fill in the chart with the appropriate words. When the children have completed the chart, discuss their answers.

4. If a child correctly fills in most of the answers on the chart, you may assume that he or she has demonstrated the objects for the cluster and is ready to go on to the next cluster.

****

Level 3 Unit 2 Space and Motion

Part C Motion, Lesson Cluster 2C-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson and Title	Teaching Time Suggested
T-214	Introduction	Motion Blurs	35-40 min.
T-215	Development	What Moved?	15-20 min.
T-216	Development	You Can Be Fooled	20-25 min.
T-218	Development	Tracks	35-40 min.
T-220	Development	Interaction Clues	35-40 min.
T-222	Application	Which Parts Moved?	25-30 min.
T-223	Evaluation	Find the Clues	15-20 min.

B. MATERIALS: See list on page T-211.

INTRODUCTION: Lesson Cluster 2C-2 Clues of Motion
Page T-214/S-117 Motion Blurs (35-40 min.)

PURPOSE: To increase awareness of evidence of motion to be found in photographs.

ADVANCE PREPARATION: Materials - instant-developing camera, a small car, string, old magazines, scissors, bulletin board space.

Language Cards/Key Signs
a blur
a clue
a camera
a photograph

Identification Cards

TEACHING SUGGESTIONS:

1. Show the children the car. Place it on a desk. Place another object on the desk as a reference object. Take a picture of the car. Then ask one child to put the car with the string. Take another picture. Ask another child to pull the car faster and take a picture of that. Compare and discuss the three photographs.

2. To increase the children's awareness of motion in photographs, pass out the old magazines. Have the children look for pictures which show evidence of motion. Have them cut out the pictures and glue them on a piece of paper. Then ask the children to write a sentence about the moving object in the picture. The moving object(s) can be circled with a crayon.

3. Have the children look at page 117. Discuss the pictures as before. Discuss the moving and non-moving objects.

DESIRED LEARNING OUTCOME: The children should be able to interpret and describe blurs in photographs as evidence of motion.

****

DEVELOPMENT: Lesson Cluster 2C-2 Clues of Motion
Page T-215/S-118 What Moved? (15-20 min.)

PURPOSE: To continue development of the ability to interpret evidence of motion from photographs.

ADVANCE PREPARATION: Materials - textbook

Language Cards/Key Signs

Identification Cards

TEACHING SUGGESTIONS:

1. Refer the children to page 118 and have them identify the moving objects in each picture. Then discuss each picture with them.

2. Point out to the children that in the second picture distance from the camera as well as speed affects the amount of blur. Of course the kind of lens used, shutter speed, and other factors also affect the amount of blur,

DESIRED LEARNING OUTCOME: Children should be able to interpret motion blurs in photographs.

****

DEVELOPMENT: Lesson Cluster 2C-2 Clues of Motion
Page T-216/S-119 You Can Be Fooled (20-25 min.)

PURPOSE: To continue development of the ability to interpret evidence of motion from photographs.

ADVANCE PREPARATION: Materials - Camera.

Language Cards/Key Signs
to be fooled
a camera

Identification Cards

TEACHING SUGGESTIONS:

1. Tell the children that they will be discussing more about motion. Take some pictures with the camera. Have the children move around (dancing is a good activity) while you take the pictures. With one or two pictures move the camera as you are taking the pictures. Try to do this without the children noticing.

2. Take all of the photographs. Have the children compare them. Ask them which things in the photographs were moving. See if they will develop the idea that the camera moved. If this idea does not come out, take two more pictures, one where the children move and one where the camera moves. Again have them compare the pictures.

3. Have the children look at page 119. Read the text with the children and discuss the pictures.

4. Ask the children to block out the people and the car in the bottom picture. What remains are such objects as trees, the house, fence, etc. How can these objects be used to show that the camera did indeed move? The obvious answer is that the houses, etc. cannot move.

DESIRED LEARNING OUTCOME: The children should be able to determine whether blurs in a photograph are the result of movement of the object or of the camera.

****

DEVELOPMENT: Lesson Cluster 2C-2 Clues of Motion
Page T-218/S-120 Tracks (25-40 min.)

PURPOSE: To continue development of ability to interpret and describe evidence of motion.

PREREQUISITES: Exposure to the concept that objects make tracks.

ADVANCE PREPARATION: Materials Locate various tracks outside the school building for field trip.

Language Cards/Key Signs
tracks
a mark
a clue of motion
a bike tire
a paw print
direction

Identification Cards

TEACHING SUGGESTIONS:

1. Tell the children that you will be taking a walk. You will be looking for things outside on the ground. Walk outside to the places which you have already found as having tracks. Show the tracks to the children and ask what they are. Try and find tire tracks, footprints, and animal prints if possible.

2. Have the children look at page 120. Discuss the text and the pictures. Ask a child to explain the tracks in each picture. Question the children about the motion shown by the tracks.

3. Have the children look at page 121. Explain that tracks can show motion and direction. Have the children discuss these pictures with those things in mind.

DESIRED LEARNING OUTCOME: The children should be able to describe motion and infer direction from tracks.

****

DEVELOPMENT: Lesson Cluster 2C-2 Clues of Motion
Page T-220/S-122 Interaction Clues (35-40 min.)

PURPOSE: To apply the concepts of position and motion in interpreting evidence of motion.

ADVANCE PREPARATION: Materials - two toy cars

Language Cards/Key Signs
interaction
clues of motion
a windshield
a hammer
a branch
an ax
a stump

Identification Cards

TEACHING SUGGESTIONS:

1. Remind the children that two objects cannot occupy the same space at the same time. Demonstrate what can happen if one object tries to occupy the same position as another. The following are some suggested demonstrations using two toy cars.

2. Gently nudge one car with the other. The change in position is evidence of motion.

3. Crash one car into the other. The evidence of motion is change of position and damage to one or both cars.

4. Crash the two cars together. Here the evidence is change of position and damage to one or both cars.

5. Sideswipe (scrape) one car with the other. Evidence of motion may be scratches and scraped paint.

6. Summarize by noting that when objects collide they may leave evidence in the form of changes in position and changes in properties (dents, scratches, crumpling, tearing, breaking, and so on). Objects can collide without damage, however, as with a bouncing ball, bowling balls and pins, football players, and so on.

7. Have the children look at pages 122-123. Discuss each picture including vocabulary words. Have the children explain what the interaction was, and between which objects.

8. Emphasize that some interactions involving moving objects are less obvious. Moving wind and water, for example, can interact with soil and rock to gradually wear it away.

9. If the children have any difficulties with the aspect of interaction, then they could try to perform the interaction, hammering wood, dropping stones into a bowl of water, etc.

DESIRED LEARNING OUTCOME: The children should be ablo to discuss and interpret evidence of interactions involving motion.

****

APPLICATION: Lesson Cluster 2C-2 Clues of Motion
Page T-222/S-124 Which Parts Moved? (25-30 min.)

PURPOSE: To further apply the concepts of position and motion in interpreting evidence of motion.

ADVANCE PREPARATION: Materials - textbook
a clock
a timer

Language Cards/Key Signs
a clock
a bicycle
a pedal
a reflector
a timer

Identification Cards

TEACHING SUGGESTIONS:

1. Show the children a clock. Ask them to look carefully at the clock. Then turn around and change the time on the clock. Again show it to the children. Ask if anything was moved. Discuss their answers.

2. Show the children a timer. Again show it to them in two positions. Ask what has moved, if anything.

3. Have the children turn to page 124. Discuss each set of pictures with them. Ask them which part has moved. Also ask them how they know the part has moved. Ask them to identify the moving object and the reference object for each set of pictures.

DESIRED LEARNING OUTCOME: The children should be able to discuss and interpret evidence of interactions involving motion.

****

EVALUATION: Lesson Cluster 2C-2 Clues of Motion
Page T-223/S-125 Find the Clues (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:

1. Descriging and interpreting evidence of motion from drawings and photographs.
2. Describing and interpreting tracks as evidence of motion.
3. Describing and interpreting the effects of interactions as evidence of motion.

ADVANCE PREPARATION: Materials - student answer paper.

TEACHING SUGGESTIONS:

1. Ask the children to look at page 125. Discuss each of the pictures. Write the vocabulary words from the pictures on the board. Ask the children to explain the terms blur, track, and interaction.

2. Have the children fill in the answers on the student answer paper. When they have finished, discuss their answers.

3. If a child correctly makes all of the matches, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

Language Cards/Key Cards
a runner
a motorcycle
bowling
pins
a bowling ball

Identification Cards

****

Unit 2 Space and Motion

Part C Motion, Lesson Cluster 2C-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-230	Development	Study the Tracks	25-30 min.
T-228	Introduction	Paths of Motion	30-35 min.
T-231	Development	Viewing Paths	15-20 min.
T-232	Application	Draw the Paths	20-25 min.
T-233	Evaluation	Find the Motion	15-20 min.

B. MATERIALS: See list on page T-225.

FILMSTRIP INFORMATION: Filmstrips Sets VII, Place and Motion, and XI, Motion and Change, are appropriate for use in this unit.

DEVELOPMENT: Lesson Cluster 2C-3 Describing Motion
Page T-230/S-128 Study the Tracks (25-30 min.)

PURPOSE: To develop the ability to describe the paths of moving objects.

ADVANCE PREPARATION: Materials
- lids to cardboard boxes
- flour
- wind-up toys for each pair of students
- plain white paper

Language Cards/Key Signs
a cardboard box
flour

Identification Cards

TEACHING SUGGESTIONS:

1. Pass out the materials to each group of two children. Have them set up the box as shown. Explain that they are to observe the paths of the objects.

2. Tell the children that they are to wind up each toy. They put the toy into the box and observe its path in the flour. After each toy has made a path, they are to copy the path on a piece of white paper. Then they can cover up the path and try the next toy.

3. After the children have completed the task, put their drawings on the board. Discuss the paths that the toys have taken. See if the children have any words for the paths.

DESIRED LEARNING OUTCOME: The children should be able to observe and tell about the motion of self-propelled objects.

****

INTRODUCTION: Lesson Cluster 2C-3 Describing Motion
Page T-228/S-126 Paths of Motion (30-35 min.)

PURPOSE: To reinforce the concept of paths of motion, and add terminology to the paths previously observed.

ADVANCE PREPARATION: Materials - large cards showing the four paths
- a top
- a sink with water
- a plastic ball tied to a string
- a washer tied to a string

Language Cards/Key Signs
a circular path
a straight path
a swinging path
a spiral path
direction
arrow

Identification Cards

TEACHING SUGGESTIONS:

1. Place the language cards and the picture cards for the four movements on the board. Ask one child to walk from point A to point B (which is a straight line). Ask the class which path the child took.

2. Use a washer hung from a string. Have one child hold the string and another child swing the washer. Again ask which path of movement is being shown.

3. Go to a sink. Put water in the sink and watch it go down the drain. Again ask about the path of motion.

4. Give one child the ball tied to the string. Ask the child to spin around. Ask the other children to watch the movement of the ball. Have them identify the path of motion.

5. Each time a path of motion is discussed, see if the children can give other examples of that type of motion.

6. Have the children look at pages 126 and 127. Discuss each picture and the path of motion. Explain that these four paths are only examples. All the paths can vary in size and many other paths are possible. See if the children can think of other possible paths.

DESIRED LEARNING OUTCOME: The children should be able to describe several different paths of motion.

****

DEVELOPMENT: Lesson Cluster 2C-3 Describing Motion
Page T-231/S-129 Viewing Paths (15-20 min.)

PURPOSE: To develop the ability to describe the motion of objects from more than one viewpoint.

ADVANCE PREPARATION: Materials - textbook
- a yo-yo

TEACHING SUGGESTIONS:

1. Using a yo-yo, demonstrate whirling it in various positions in front of the children. First face the children as you whirl the yo-yo.

2. Turn your body sideways relative to the front of the class and whirl the yo-yo again. Have the class discuss how the paths look different and why they look different. Ask what the reference object is - each child, or you and the yo-yo. In the demonstrations each child is the reference object that doesn't move. You and the yo-yo change positions from one demonstration to the next.

3. Repeat the two demonstrations and have the children draw the paths taken by the yo-yo as seen from two different views.

4. Have the children read and discuss page 129. Have them draw the paths taken by the object shown in the two different views.

Language Cards/Key Signs
different views
a yo-yo
a front view
a side view

Identification Cards

DESIRED LEARNING OUTCOME: The children should be able to describe the motion of objects as seen from more than one viewpoint.

****

APPLICATION: Lesson Cluster 2C-3 Describing Motion
Page T-232/S-130 Draw the Paths (20-25 min.)

PURPOSE: To reinforce the ability to describe the motion of objects.

ADVANCE PREPARATION: Materials - language cards from previous lesson on paths of movement
- student answersheet

Language Cards/Key Signs
a circular path
a straight path
a swinging path
a spiral path
direction
arrow

Identification Cards

TEACHING SUGGESTIONS:

1. Place the language cards and the pictures of the four paths of movement on the board. Review each path.

2. Have the children look at page 130. Ask them to look at each picture and decide which path of movement is shown. Have them draw their answers on the answer sheet. Ask them to label their drawings with the correct term.

3. When the children have completed their answers, discuss them as a group.

4. These drawings, along with the language cards and pictures, and pictures from the book could be used as a bulletin board.

DESIRED LEARNING OUTCOME: The children should be able to describe the motion of objects by drawing their paths.

****

EVALUATION: Lesson Cluster 2C-3 Describing Motion
Page T-233/S-131 Find the Motion (15-20 min.)

PURPOSE: To evaluate the children's performance in describing some of the kinds of paths taken by moving objects.

ADVANCE PREPARATION: Materials - student answersheet

TEACHING SUGGESTIONS:

1. Have the children look at the pictures on page 131. Pass out the answersheets. Ask the children to fill in the correct letter for each question.

2. When the children have completed the questions, discuss their answers.

3. If a child correctly identifies all of the paths, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 3 Unit 3 Interaction and Energy

Part A Interaction, Lesson Cluster 3A-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-244	Introduction	Interacting Objects	40-45 min.
T-246	Development	Pick a System	35-40 min.
T-248	Application	Naming Systems	20-25 min.
T-250	Enrichment*	Picture This	40-45 min.
T-252	Evaluation	Many Systems	15-20 min.

Note: Only if the children's language level includes many verbs.

B. MATERIALS: Add the following to the list on page T-241 -
- hammer, nail, wood
- cream, electric mixer, bowl, knife, crackers
- saw
- cloth (scraps)
- scissors
- thread
- needle
- paper
- pencil
- pencil sharpener

FILMSTRIP INFORMATION: Filmstrip Set VIII, Moving and Mixing, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3A-1 Interaction and Systems
Page T-244/S-134 Interacting Objects (40-45 min.)

PURPOSE: To review the concepts of interaction and system, and to provide practice in identifying interactions.

PREREQUISITES: Previous experience with concepts of interaction and systems.

ADVANCE PREPARATION: Materials - cream, bowl, mixer, etc.
(to make butter)
- hammer
- nails
- wood

TEACHING SUGGESTIONS:

Language Cards/Key Signs
interaction
system
cream
butter
a cracker
lawn mower
a grass collector
a puddle
a curb

Identification Cards
same as Language Cards

1. To remind the students about interaction/systems concepts - write the two words on the board.
2. Proceed to show children the materials for making butter. Name the materials using the Language Cards.
3. Have the children take turns whipping the cream. As they are doing this, ask the children What is the interaction, and Which objects make up the system?
4. While the students are eating their crackers and butter (or it could be saved for a later time) bring out the hammer, nails, and wood. Hammer the nail into the wood and ask the same questions again.
5. On a transparency (or board) using the words system and interaction, have the children list each of the systems' objects and the interactions which occurred.

System	Interaction	Change

6. Have the children look at page 134-135. First discuss and list the objects in each system (on chart). Then discuss and record the interaction. Emphasize that change is an indication that an interaction has taken place.
7. Ask the children to look for interactions of systems within the classroom. (Possibilities are: turning off lights, opening door). Discuss the change that occurred as a result of the interaction.

DESIRED LEARNING OUTCOME: The children should be able to identify the objects in a system and describe the interactions that took place in the system in terms of the changes they observe.

****

DEVELOPMENT: Lesson Cluster 3A-1 Interaction and Systems
Page T-246/S-136 Pick a System (35-40 min.)

PURPOSE: To further review the concepts of interaction and system, and to provide practice in grouping objects into systems and describing how these objects might interact.

ADVANCE PREPARATION: Materials
- cloth
- scissors
- thread
- needle
- saw
- textbook

hammer
nails
wood
pencil sharpener
pencil

student worksheet:

System	Possible Interaction

Language Cards/Key Signs
cloth
scissors
a needle
chalk
thread
a pencil sharpener
a rake
a trowel
soil
a system
interaction

Identification Cards
same as Language Cards

TEACHING SUGGESTIONS:

1. Place all of the objects on a table, in no particular order. Again, write the words system and interaction on the board.
2. Have the children name the objects. Write the names on the board.
3. Ask the children to choose objects that could make a system. Discuss the system and the possible interactions.
4. Pass out the student worksheets. Instruct the children how to fill them out using the objects on the table. Emphasize that there are many possible answers. Also remind the class that people may be part of a system and that more than one interaction can occur in a system.
5. Move around the room while the children work, provide additional answers, and check to see that everyone understand the concepts of interaction and system. Help with spelling and/or vocabulary when necessary.
6. When the children complete their worksheets (allow about 10 min.), discuss their answers.
7. Have the children look at page 137. Have them name the objects, and discuss the possible systems and interactions.
8. Conclude the lesson by asking the children to find objects in their desks or room that might form a system. Ask them to explain how interaction might take place in the system.

DESIRED LEARNING OUTCOME: The children should be able to identify objects that might form systems and predict how they will interact.

****

APPLICATION: Lesson Cluster 3A-1 Interaction and Systems
Page T-248/S-138 Naming Systems (20-25 min.)

PURPOSE: To introduce the idea that systems can be named for the interactions that take place within them.

PREREQUISITES: Experience with a variety of verbs, especially those included in the lesson. (These could be included in a previous language lesson.)

ADVANCE PREPARATION: Materials - hammer
- nail
- wood
- textbook

Language Cards/Key Signs
a camera
a sled
a brick
a window
a flash cube
a baseball
flashing
crushing
hitting
a bat

Identification Cards

TEACHING SUGGESTIONS:

1. Again, hammer a nail into a piece of wood. Ask the children to name the objects in the systems, and the interaction. Tell the children that the system could have a name. The name would be a verb that describes the interaction. See if the children can develop a name for the system.

2. Have the children look at page 138. Have them name each object on the page. Write the names on the board (or use Language Cards).

3. Then ask the children to make systems with the object. If Language Cards are used, a child could be asked to pick the cards and place them together.

4. Continue the lesson on page 139. Have the children look at the words. Write the verbs on the board and discuss the meaning of each.

5. Have the children place the correct word with the previously developed system.

6. For further practice, have the children think of other systems of objects. Have them think of a name for the system.

7. Point out that many different systems may have the same name, and ask the children to give examples. (i.e. hitting systems: ball/bat, hammer/nail)

8. Extend the concept of naming systems by poing out that a single system in which several interactions occur, may have more than one name. (i.e. swinging a bat/ hitting a ball)

DESIRED LEARNING OUTCOME: The children should be able to match objects to form systems and to match these systems to names based on their interactions.

****

ENRICHMENT: Lesson Cluster 3A-1 Interactions and Systems
Page T-250 Picture This (40-45 min.)

PURPOSE: To extend the concept that systems can be named for the interactions that take place within them and to provide practice in naming systems and identifying the interactions taking place. This lesson does not appear in the student text.

PREREQUISITES: Previous experience with verbs used in lesson. This could be done in a language lesson.

ADVANCE PREPARATION: Materials - construction paper
- pens or crayons
- 10-15 pictures of interacting objects

Language Cards/Key Signs
those verbs used in pictures

Identification Cards

1. Collect 10-15 pictures of interacting objects from magazines or newspapers. Choose only those pictures which show actions with which the children are familiar. Mount the pictures on heavy cardboard.

2. Make large cards on which are printed the vocabulary words from T-250 that the children already know.

TEACHING SUGGESTIONS:

1. To enable the children to extend their skills in naming systems, divide the class into pairs and have each pair choose two of the pictures you have prepared.
2. Begin the activity by explaining to the class that the job of each pair is to create a name card (using construction paper) that names their system. Give each pair a piece of construction paper and a crayon.
3. Challenge the children to be imaginative. Encourage the pairs to portray the names of their systems as action words. They should try to write the names in ways that effectively represent what took place. Some examples of names are shown in Figure 3-1. You may want to copy these names on the chalkboard as examples for the children.
4. Use the pictures and the children's work to create a bulletin board display on interaction and systems.

DESIRED LEARNING OUTCOME: The children should be able to name systems in terms of the interactions that take place within them and write the names in a way that depicts the action taking place.

* * *

EVALUATION: Lesson Cluster 3A-1 Interaction and Systems
PageT-252/S-140 Many Systems (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:
1. Describing evidence of interaction in a system.
2. Naming systems in terms of the interactions of their parts.

ADVANCE PREPARATION: Materials - textbook
- students answersheet

1)			
2)			

This leaves room if the child uses more than one verb.

Language Cards/Key Signs
hitting
throwing
shooting
swinging

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson by asking the children to turn to pages 140-141.

2. Discuss each picture. Have the children name the objects in each system.

3. Tell the children that they must identify the system name(s) that go with each picture. Instruct them to write the words next to the number of the appropriate picture. Tell the children that they may choose more than one name for a picture. The student answer sheet should indicate this.

4. When the children have finished, discuss their answers with them.

5. If a child correctly matches most of the names of the systems, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Unit 3 Interaction and Energy

Part A Interaction, Lesson Cluster Outline 3A-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-258	Introduction	Change in a System	35-40 min.
T-260	Development	Working with Variables	35-40 min.
T-262	Enrichment	More Wobble Systems	40-45 min.
T-263	Application	Sports Variables	20-25 min.
T-264	Evaluation	Name the Variables	15-20 min.

B. MATERIALS: See list on page T-255.

FILMSTRIP INFORMATION: Filmstrip Set VIII, Moving and Mixing, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3A-2 Variables in Systems
Page T-258/S-142 Change in a System (35-40 min.)

PURPOSE: To introduce the concept of variable and to demonstrate how changes occur within a system when a variable is manipulated.

PREREQUISITES: Exposure to the concept of reflection of light.

ADVANCE PREPARATION: Materials - For each pair of students have:
- flashlights (make sure they produce a focused spot of light)
- mirrors
- clay
- balls
- textbook

Language Cards/Key Signs
a flashlight
a mirror
clay
a ball
a variable
to reflect

Identification Cards

Background Information - There are many different meanings of the term variable. In this unit, variable refers to any quantity or quality of objects that can be changed. Variable often refers to the properties that are changed in a system from one experiment to another. Objects themselves are not the variables investigated. Rather, the properties of objects are the variables studied.

TEACHING SUGGESTIONS:

1. To begin the lesson, display the materials on a table. Ask the children to name the objects. Tell them that this could be a system. Show the children how to put the mirror into the clay to make it stand. Give each pair of children a flashlight, mirror, clay, and ball.

2. Give the children about 10 minutes to "play" with the objects. Circulate among them, trying to guide them towards the concepts of reflection, and placement of objects. Discuss their findings.

3. Then ask the children to watch as you do a demonstration. Show the system as pictured on page 142, column 1. Then show the second system from page 142. Ask what has changed.

4. Write the word variable on the board. Tell the children that a variable is something in a system that can change. Write this definition on the board. Emphasize that when you change the variable, the interaction in a system is different.

5. Have the children look at page 143. Ask them to place their objects as in Position A. Ask them the questions on page 143, column 1.

6. Then have the children change the objects to Position B. Again ask the questions listed on page 143, column 2.

7. Ask the children to manipulate the objects and demonstrate other variations in the system. Have each pair of children take turns doing this.

8. Ask the children what the term variable means.

DESIRED LEARNING OUTCOME: The children should be able to explain the term variable and demonstrate how to manipulate a variable in a system to produce change.

****

DEVELOPMENT: Lesson Cluster 3A-2 Variables in Systems
Page T-260/S-144 Working With Variables (35-40 min.)

PURPOSE: To develop the concept that many variables may exist in a system and to provide practice in manipulating variables in order to produce changes in a system.

ADVANCE PREPARATION: Materials - A chart with directions for making A Wobble System, (including drawings if necessary), in language appropriate for the children.
- For each pair of students have:
- a long piece of string (1.5 meters)
- 4 pieces of string of various lengths
- 4 washers
- 2 chairs from classroom

Language Cards/Key Signs
a variable
a wobble system
a washer
string
fastest
slowest

Identification Cards
same as Language Cards

TEACHING SUGGESTIONS:

1. Write the terms "A Wobble System" on the board. Display the materials on a table. Explain to the children that they will be using the materials to make a wobble system.

2. Display the previously prepared chart. Have the children read the directions. Have the children, working in pairs, set up their own wobble systems.

3. After they have set up the systems, have them try out their systems. Walk among the children, and encourage them to discover the best way to swing the pendulum and, how the pendulums swing in comparison.

4. After about 10 minutes of "guided play" ask the children, What is the best way to swing the washers? If they have not discovered the best way, show them the appropriate method. Point out the importance of avoiding contact with the other pendulums. (They must be swung at right angles to the cord connecting the two chairs.)

5. Ask the children what they noticed about the speed of the swinging washers. Ask them which washer swung the fastest, and which swung the slowest.

6. Ask them to swing only one washer. Discuss the results.

7. Ask them to hold all of the washers at one end, near one chair and then swing them. Discuss the results.

8. Have the children list (on the board) some variables in the wobble system (i.e. length of string between chairs, tautness of string). It is also important to suggest variables.

DESIRED LEARNING OUTCOME: The children should be able to identify a few variables in a system, and discuss the changes resulting in their manipulation.

****

ENRICHMENT: Lesson Cluster 3A-2 Variables in Systems
Page T-262 More Wobble Systems (40-45 min.)

PURPOSE: To further develop the concept that manipulation of variables produces changes in a system. This lesson does not appear in the student text.

ADVANCE PREPARATION: Materials - Wobble systems from the previous lesson
- additional washers
- string available for the students' use

Background Information - Omit the last 2 sentences of the text.

Language Cards/Key Signs
variables

Identification Cards

TEACHING SUGGESTIONS:

1. Have the children reconstruct the basic wobble system. Have them work in the same pairs as before.

2. Have a brief discussion of a variable. Discuss how variables can be changed in a system.

3. Tell the children that this time they may add more variables to their systems. Give them the additional washers and string.

4. Ask the children to try out various changes, and then choose one system to show the class at the end of the lesson.

5. Give the children 10-15 minutes to develop their system. Walk among the groups to see how they are doing.

6. Have each pair explain the variables in their system and how the system works (i.e. comparing speed of movement). Discuss the differences among the different systems.

DESIRED LEARNING OUTCOME: The children should be able to construct their own systems and manipulate the variables in their systems.

****

APPLICATION: Lesson Cluster 3A-2 Variables in Systems
Page T-263/S-146 Sports Variables (20-25 min.)

PURPOSE: To provide practice in identifying variables in a system and to apply the concept of variable to an everyday situation.

ADVANCE PREPARATION: Materials - textbook

TEACHING SUGGESTIONS:

Language Cards/Key Signs
a team
a softball game
sports
variable

Identification Cards
same as Language Cards

1. Have the children look at page 146. Discuss the page, including the vocabulary listed above.

2. Discuss the different ways a softball can be thrown and hit. Emphasize that these are variables because they are not always the same.

3. Ask the children to explain what is happening in the pictures of Sally and Margaret. Ask them the questions listed then and discuss their answers.

4. Ask the children to name their favorite activity or sport. Write them on the board.

5. For each activity listed, have the children try to identify the variables that make a difference in one's likelihood of performing well. You might point out the variables that the children may overlook: physical conditions of players, weather, conditions of playing area.

DESIRED LEARNING OUTCOME: The children should be able to identify variables in a sports activity and predict how variables may affect the outcome of the activity.

****

EVALUATION: Lesson Cluster 3A-2 Variables in Systems
Page T-264/S-147 Name the Variables (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:
1. Identifying a variable in a system.
2. Determining the effect of a variable in a system.

ADVANCE PREPARATION: Materials - textbook
- student answersheet

	Picture 1	2
objects in system		
variable		

Language Cards/Key Signs
a pond
lilly pads
frog
ice
snow

Identification Cards

TEACHING SUGGESTIONS:

1. Ask the children to look at the pictures on page 147.
   Have the children name the various objects in both systems (in no particular order).
   Write these on the board.

2. Pass out the student answersheet. Explain how it is to be filled in. Ask the children to look at page 147 and fill in the chart.

3. After the children have completed their papers, discuss their answers.

4. If a child correctly answers the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Unit 3 Interaction and Energy

Part A Interaction, Lesson Cluster 3A-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-270	Introduction	Energy	35-40 min.
T-272	Development	Moving Systems	20-25 min.
T-274	Development	Energy Givers You Cannot See	20-25 min.
T-275	Application	Moving Systems In Your Classroom	25-30 min.
T-276	Evaluation	Energy Givers and Receivers	20-25 min.

B. MATERIALS: Add the following to the materials list on page T-267 -
- show box full of heavy objects
- 2 ping pong balls

FILMSTRIP INFORMATION: Filmstrip Set VIII, Moving and Mixing, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3A-3 Energy in Systems
Page T-270/S-148 Energy (35-40 min.)

PURPOSE: To introduce the concept of energy in systems and to provide practice in identifying moving systems.

PREREQUISITES: Exposure to the concept of energy.

ADVANCE PREPARATION: Materials - a shoebox full of heavy objects like rocks
- textbook
- large cards with words:
"a hitting system,"
"a crashing system,"
"a throwing system,"
"a pushing system,"
"a swinging system,"
"a cutting system"
- tape

Background Information - Energy is all around us. But energy is not an object and cannot be observed directly. We can only infer the existence of energy by observing the changes in systems that are brought about by the interactions of objects.

Language Cards/Key Signs
energy
interaction
crashing
sliding
hitting
moving systems

Identification Cards
energy
interaction
crashing
sliding
hitting
moving systems

Energy is usally defined as the ability to do work, but this definition is too abstract for children at this level. In this lesson, the children come to understand one form of energy through a classification technique. Interactions are grouped according to a similar effect occurring in each one. By grouping these interactions, a common form of energy becomes apparent. The group is named according to the form of energy involved.

Hitting, crashing, and sliding systems all have the effect of movement. Therefore, they all involve energy of motion (kinetic energy). These and other systems with motion energy may be called moving systems to indicate the form of energy involved.

TEACHING SUGGESTIONS:

1. Place the shoe box on one end of a table in front of the class. Place a piece of tape in front of the box and another piece at the other end of the table.

2. Ask the children how you could get the box from one mark to the other without taking it off the table. (Sliding, pushing, moving). Ask them the name of the system.

3. Write the word energy on the board. Ask the children to tell you about energy. Encourage the children to describe energy in terms of the movement of objects. Relate the discussion of energy to the pushing system which they were using.

4. Have the children look at pages 148-149. Read the text to the children (page 148) using the language cards as the words appear.

5. Ask the children to name the systems pictured on these two pages. Then ask them to describe the effect energy has had in each system.

6. Ask the children what is the same about the three systems. If necessary, explain that all objects are moving in the system. Write the words moving systems on the board.

7. Read the text from page 149 to the children. Relate the idea of energy/moving systems.

8. Ask the children to think of other moving systems. To encourage their thinking, display thelarge cards one by one.

9. After the completion of the lesson, make a bulletin board with the large cards and any pictures that the children can find in magazines or draw themselves (possibly as homework.)

DESIRED LEARNING OUTCOME: The children should be able to explain how objects may have motion energy and identify moving systems.

****

DEVELOPMENT: Lesson Cluster 3A-3 Energy in Systems
Page T-272/S-150 Moving Systems (20-25 min.)

PURPOSE: To introduce the concept of energy transfer from an energy giver to an energy receiver in a moving system.

PREREQUISITES: The ability to write/understand sentences - noun and verb and direct object.

Note: Similar pictures used in this lesson could be used in a previous language lesson, to help students develop skill in writing N + V + DO (noun + verb and direct object sentences). This could then be reinforced in the science lesson by having the students write a sentence about the picture, and then note who is the energy receiver and who is the energy giver.

ADVANCE PREPARATION: Materials
- shoebox filled with heavy objects ready
- textbook
- pictures from magazines showing energy givers and receivers mounted on heavy cardboard
- title for bulletin board - Energy Givers and Energy Receivers

Language Cards/Key Signs
the energy giver
the energy receiver

Identification Cards

TEACHING SUGGESTIONS:

1. Place the shoebox on the table again. Ask the children what system they used previously. Ask a child to demonstrate.

2. Hold up the language cards - the energy giver and the energy receiver. Ask the children if they can guess what they mean. Explain the two terms in relation to the box and child.

3. Have the children look at pages 150-151. Read the text on 150 to them. Ask the children to think of a sentence about the boy and the ball. Write it on the board. Ask who is the energy receiver/energy giver. Underline or circle each one.

4. Go through the other pictures in the same way, asking for a sentence first, then asking who the giver/receiver is.

5. (The following activity could be done as a continuation of the lesson, or as a review of the language lesson.) Group the children in pairs. Give each pair 4 or 5 pictures, and a piece of paper. Have the following directions. "Write a sentence for each picture. Under line the energy giver. Circle the energy receiver." (Directions could be modified according to their language level.) Use these papers and pictures along with the title as a bulletin board.

DESIRED LEARNING OUTCOME: The children should be able to identify the energy givers and energy receivers in moving systems.

* * *

DEVELOPMENT: Lesson Cluster 3A-3 Energy in Systems
Page T-274/S-152 Energy Givers You Cannot See (20-25 min.)

PURPOSE: To further develop the concept of energy transfer in moving systems by providing practice in inferring the identity of energy givers.

ADVANCE PREPARATION: Materials
- ping pong ball(s)
- textbook

Language Cards/Key Signs
sailboat

TEACHING SUGGESTIONS:

Language Cards

1. Place one or two ping pong balls on a table. Have the children sit around the table, placing their arms under the table.

2. Tell them that they are going to play a game. They will blow on the ball and try to keep it on the table. The person who lets the ball go off the table is out. Play this for a few minutes.

3. Stop the game and ask the children to name the energy giver/receiver.

4. Have the children look at page 152. Read the text to them. Ask them to identify the giver/receiver. Be sure that they understand that the wind and not the child is the energy giver.

5. With the sailboat picture, a child might name the water as an energy giver. Agree that this may also be an energy giver, but point out that the class should name an energy giver that they cannot see (wind).

6. The idea of inferred energy givers may be difficult for some children. If this happens, more hands-on examples might help (pinwheel, etc.).

DESIRED LEARNING OUTCOME: The children should be able to name an energy giver that they cannot see in a system.

****

APPLICATION: Lesson Cluster 3A-3 Energy in Systems
Page T-275/S-q53 Moving Systems in Your Classroom (25-30 min.)

PURPOSE: To apply the concepts ofmoving system and energy giver and energy receiver to systems in the classroom.

ADVANCE PREPARATION: Materials - textbook

Language Cards/Key Signs
a shade

Identification Cards

TEACHING SUGGESTIONS:

1. Have the childrenlook at page 153. Discuss each picture. Ask what/who is the giver/receiver.

2. Ask the children to look in their classroom and find energy systems and to describe the system and the energy givers and receiver.

3. Write their ideas on the board using a format like this:

Moving System	Energy Giver	Energy Receiver

4. Discuss the childrens' ideas, as they are written on the board.

DESIRED LEARNING OUTCOME: The children should be able to identify the energy givers and energy receivers in moving systems in their classroom.

****

EVALUATION: Lesson Cluster 3A-3 Energy in Systems
Page T-276/S-154 Energy Givers and Receivers (20-25 min.)

PURPOSE: To evaluate the children's performance in identifying energy givers and energy receivers in moving systems.

ADVANCE PREPARATION: Materials - textbook
- student answersheet

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the children that they will be asked to identify energy givers and energy receivers as they did before.
2. Give each child the materials to be used in completing the lesson.
3. Discuss the directions on page 154. Answer any questions which the students have.
4. Be sure they understand what to do before you allow them to begin working.
5. Move around the room, checking the children's work and offering suggestions when necessary.
6. When everyone has finished or when you feel sufficient time has elapsed, collect the papers and review the answers.
7. If a child correctly identifies most of the energy givers and energy receivers, you may assume that he or she has demonstrated the objective for the cluster and is ready to go on to the next cluster.
8. For further information evaluation, have the children turn back to page 133 and look at the picture that introduces Part A. Ask them why they think that particular picture was used to introduce the part that they have just completed. Suggest that they look for clues in the part title and in the cluster titles on pages 134, 142, and 148. The children should be able to:
   a. identify the picture as a system;
   b. list the objects in the system (children, ball, net);
   c. describe interactions in the system (hitting the ball);
   d. describe variables in the system (how hard the ball is hit, how high the ball is hit, the height of the net, the height of the children, whether the ball hits the net, how fast the children move or how high they jump);
   e. identify the system as a moving system;
   f. identify energy givers and energy receivers in the system (energy giver: children; energy receiver: ball).

****

Level 3 Unit 3 Interaction and Energy

Part B Energy, Lesson Cluster 3B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Outline	Teaching Time Suggested
T-782	Introduction	Many Kinds of Energy	35-40 min.
T-284	Development	Magnetic Energy	25-30 min.
T-285	Development	More About Magnetic Energy	25-30 min.
T-286	Development	Motion - How Far?	35-40 min.
T-268	Application	Where is the energy	35-40 min.

NOTE: Delete Wrap-up

B. MATERIALS: Add the following to the materials list on page T-279:
- flashlight
- toy drum
- matches
- shoe box (used in Cluster A-3)
- various shapes of magnets

INTRODUCTION: Lesson Cluster 3B-1 Kinds of Energy
Page T-282/S-156 Many Kinds of Energy (35-40 min.)

PURPOSE: To introduce the concept that energy has many forms besides motion.

PREREQUISITES: Previous experience with the various forms of energy.

ADVANCE PREPARATION: Materials - shoebox from A-3
flashlight
matches
toy drum
a magnet
a textbook
pictures cut from magazines showing forms of energy
lettering for bulletin board: Kinds of Energy

Language Cards/Key Cards
motion
heat
electricity
magnetic
sound
energy
light

Identification Cards

TEACHING SUGGESTIONS:

1. Place the objects on a table in front of the class. Ask a child to explain the "shoebox system." Remind them that was an energy system of motion. Write motion on the board.

2. Tell the class that energy has different forms. Ask them to look at the flashlight. Ask what type of energy system is this? Write their response on the board. Do this for the other metals.

3. Then ask the children to look at page 156-157. Discuss each picture; name the type of energy.

4. Ask the class the questions on page 157. Write the name of the object next to the energy type.

5. Show the children the pictures one at a time. Ask them which objects are in the picture and which energy system is shown. Put the pictures on the board next to the energy type.

6. In conclusion, tell the children that they are going to study magnetic energy. You may wish to encourage them to bring to class magnets or other interesting objects to test with magnets.

DESIRED LEARNING OUTCOME: The children should be able to identify several forms of energy in different systems.

****

DEVELOPMENT: Lesson Cluster 3B-1 Kinds of Energy
Page T-284/S-158 Magnetic Energy (25-30 min.)

ADVANCE PREPARATION: Materials - a variety of magnets
2 bar magnets
10 paper clips for each student
textbook (optional)

Language Cards/Key Signs
a magnet to attract
a horseshoe to repel
a rectangle
round magnetic energy
a bar magnet

Identification Cards
a magnet to attract
a horseshoe to repel
a rectangle
round magnetic energy
a bar magnet

BACKGROUND INFORMATION: Magnets attract iron, steel, and some other metals. So magnets can make objects containing these metals move. Such objects are magnetic materials. The ends of a bar magnet are known as the north and south poles. The north pole of one magnet attracts the south pole of another, like poles repel.

Magnetic attraction is usually referred to as a force (magnetic force field), but this concept is too abstract for children at this level. In this cluster, the children come to understand magnetic attraction (force) by observing motion of objects that are attracted by magnets. The motion of these objects implies energy in the magnetic systems. This type of motion energy is referred to as magnetic energy throughout this cluster, to indicate that magnets can cause visible movement of objects.

TEACHING SUGGESTIONS:

1. Write the words a magnet and magnetic energy on the board. Ask if any of the children know what a magnet is.

2. Display the various magnets on a table. Have the children sit around the table. Place some paperclips on the table. Allow the children to explore the various kinds of magnets.

3. After the children have used the magnets, or during their exploration, give them the name for each type of magnet.

4. Then put those magnets away, and give a pair of bar magnets to each child, along with 10 paperclips.

5. Ask the children to use one magnet and some paperclips. Discuss the result.

6. Then ask all the children to use two magnets. Have them place one magnet on the table, and move the other magnet toward the first. Then have them change ends. (Note: This can be done as an exploration, without any explanation from the teacher.) Discuss these results. During the discussion emphasize the words attract and repel. Have the children use them in the discussion.

DESIRED LEARNING OUTCOME: The children should be able to describe the effect of a magnet placed near a paperclip and the effect of two magnets placed near each other.

* * *

DEVELOPMENT: Lesson Cluster 3B-1 Kinds of Energy
Page T-285/S-159 More About Magnetic Energy (25-30 min.)

PURPOSE: To develop the concept that only certain kinds of objects are attracted by a magnet

ADVANCE PREPARATION: Materials - common household objects*
one bar magnet for each child
student worksheet
copy of student worksheet on chart paper - with enough spaces for many objects (tape it on board)
textbook (optional)
tray and bar magnet for each child

Language Cards/Key Signs
(Names for objects collected by students)

Identification Cards

*Ask the children to bring in some small, common household objects such as those shown on page 159. Emphasize that they should bring several different kinds of materials (plastic, wood, metal, fabric, glass, paper, etc.).

STUDENT WORKSHEET

Object	Interacts with magnet	
	yes	no

TEACHING SUGGESTIONS:

1. Have a few of the children's objects and a magnet on a table in front of the class. Write the word interact on the board. Tell the children that they are going to find out if objects interact with a magnet.

2. Pass out the student worksheet, trays and magnets. Explain the worksheet to the class. Ask the children to place their objects in their trays.

3. As the children are working on the worksheet, move around the room to help with naming or spelling the names of their objects. As each child finishes, have them write a few of their objects from each column, on the large chart paper.

4. When all the children have completed the work, discuss the results.

5. Encourage the children to make a generalization about the objects magnets attract. (Magnets do not attract non-metal objects, and magnets attract only certain metal metal objects, such as iron or steel.)

DESIRED LEARNING OUTCOME: The children should be able to describe the kinds of objects that magnets attract and do not attract.

****

DEVELOPMENT: Lesson Cluster 3B-1 Kinds of Energy
Page T-286/S-160 Motion-How Far? (35-40 min.)

PURPOSE: To provide practice in identifying and manipulating variables in a magnetic system.

ADVANCE PREPARATION: Materials - Make up a worksheet on which are four centimeter distance testers as on page 160. Cut up the sheets. Give four to each child.
one magnet and one paper clip for each student and crayons
textbook (optional)
draw a cm distance tester on the board or transparency

Language Cards/Key Signs
a variable
a distance tester

Identification Cards
a variable
a distance tester

BACKGROUND INGORMATION: A magnet can attract magnetic materials without touching them. This is possible because the magnetic attraction extends throughout an area around the magnet, called the magnetic field. Generally, magnetic materials will be attracted most strongly by certain parts of a magnet. For example, the ends (poles) of a bar magnet attract objects more strongly than the middle.

TEACHING SUGGESTIONS:

1. Show the children the magnet, paperclip and distance faster. Ask the children if this could be a system, and if they could tell you what type of system it is (energy system, motion system, magnetic system).
*Explain the use of the distance tester.

2. Write the word variable on the board. Review this concept. Ask the children to suggest possible variables in this system. Guide them to make suggestions similar to those tests on pages 160-161.

3. As an idea is expressed, write or draw it on the board and number it. Encourage them to develop at least four tests.

4. Pass out a magnet, paperclip, four distance testers and crayons to each child. Ask them to try each test, making sure they number their papers according to what is on the board. Move around the room to check their progress.

5. After the children have finished their testing, have them share their results. Discuss any differences that may have arisen among the results. Ask them the questions listed on page 161.

6. Ask the children to speculate on the reasons for the difference (if any) created when the position of the paper clip is changed. Also ask what might be the reason for the difference created when the position of the magnet is changed, but do not explain the answer at this time. This will be investigated in the next lesson.

7. To extend the concept that magnets can move objects without touching them, you may want to demonstrate how a paper clip moves about on a sheet of paper when a magnet is moved against the underside of the paper. Have two children hold the ends of a sheet of paper to suspend it in the air so you can do the demonstration.

DESIRED LEARNING OUTCOME: The children should be able to identify variables in a magnetic system and describe the effects of manipulating the variables.

* * *

APPLICATION: Lesson Cluster 3B-1 Kinds of Energy
Page T-228/S-161 Where Is the Energy (35-40 min.)

PURPOSE: To apply what the children learned about variables in a magnetic system to the study of the strength of the magnetic field of a bar magnet.

ADVANCE PREPARATION: Materials - salt shakers with iron filings
textbook
paper, 2 sheets for each child
drawing paper (optional: see TS-11)

Language Cards/Key Signs
iron filings

Identification Cards

BACKGROUND INFORMATION: The greatest amount of energy is found when either pole of a bar magnet interacts with a magnetic object. In the previous lesson, the children received an introduction to the differences in attraction along a bar magnet when they manipulated variables in the magnetic system. This lesson develops the concept of magnetic field as the children investigate how a bar magnet interacts with iron filings. The children then relate what they know about the variables in the system to the results of their investigation.

When a bar magnet is placed over or under a sheet of paper sprinkled with iron filings (a magnetic material), the filings will arrange themselves in a pattern that reflects the magnetic field of the magnet. The concentration of iron filings will be thick at the poles of the magnet and thin near the middle of the magnet. Figure 3-2 shows what the patterns should look like.

TEACHING SUGGESTIONS:

1. Introduce the lesson by reminding the class of the variable they investigated in the previous lesson. In particular, review the results of the tests performed with the magnet in two different positions, referring the class to the pictures on pages 160-161. You may want to show the children the marks made on one of their centimeter distance testers.

2. Have the children look at page 162. Discuss the materials that will be used during the experiments. Ask them to predict what will happen when the magnet is moved toward the iron filings based on their previous investigation. Do not tell them the answer.

3. Give each child a magnet and a sheet of unlined paper. You may also want to distribute pieces of plastic food wrap and instruct the children to wrap the magnets in them. (The plastic wrap makes it easy to remove the iron filings from the magnets later.)

4. Give the salt shakers filled with iron filings on their papers and pass the shakers on to the next children until everyone is finished. Also tell the children to keep their magnets away from the filings until the experiment begins.

5. Explain the directions for the activity. You may want to demonstrate the procedure as you are explaining it. Then have the children do the activity themselves.

6. Discuss the answers to the questions on page 162. Have them compare their results with their predictions made at the beginning of the lesson.

7. Collect all the magnets (still wrapped in plastic wrap, with the iron filings), the sheets of paper, and the salt shakers.

8. To extend this lesson, you could put a magnet (without plastic wrap) under a sheet of paper sprinkled with iron filings to demonstrate the pattern formed by the filings (see Figure 3-2). You may need to tap the paper or table to get the filings to move. Have the children compare the result with the results of their previous experiment. Explain that magnetic attraction operates even through certain materials, and remind the children of the previous demonstration witha paper clip. Likewise, a magnet wrapped in plastic wrap still attracts iron filings.

8. Continue the demonstration by sprinkling iron filings on two more sheets of paper and then placing two magnets under each sheet. For one sheet, the magents should have like ends facing each other but not touching. For the other sheet, unlike ends should face each other but not touch. Ask the children to describe the resulting patterns. Sample patterns made with two magnets are shown in Figure 3-3. Remind the children of their findings with two magnets in lesson (2) on page 158.

10. To familiarize yourself with the possible outcomes, you may want to experiment with the magnets before you do these demonstrations with the children.

11. This demonstration may be further extended by having the children draw the different patterns formed on the paper by the magnets and iron filings. You may want to display the drawings in the classroom.

DESIRED LEARNING OUTCOME: The children should be able to describe differences in amount of energy in a bar magnet system.

****

Level 3 Unit 3 Interaction and Energy

Part B Energy, Lesson Cluster 3B-2

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-296	Introduction	Controlling Energy	40-45 min.
T-299	Development	More and More Energy	30-40 min.
T-300	Development	Target the Energy	35-40 min.
T-301	Application	Giving Energy	20-25 min.
T-302	Evaluation	Energy Control	20-25 min.

B. MATERIALS: See list on page T-293.

FILMSTRIP INFORMATION: Filmstrip Set VIII, Moving and Mixing, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3B-2 Making Energy Changes
Page T-296/S-164 Controlling Energy (40-45 min.)

PURPOSE: To introduce the concept of control of the amount of energy transferred in a moving system.

ADVANCE PREPARATION:

Background Information: A pendulum is usually a weight suspended from a fixed point by a thread or wire. If this weight is pulled to one side and released, gravity causes it to swing back and forth at a regular rate. In this lesson, the children make a pendulum by attaching one end of a string to a plastic filmstrip case (small weight) and tying the other end to a pencil taped to a table top (fixed point).

Language Cards/Key Signs
- string
- a pencil
- tape
- a filmstrip case
- a centimeter
- a pendulum
- an energy giver
- an energy receiver

Materials -make a chart (transparency) on directions for making the pendulum in language the children can read
-for each pair of children:
-filmstrip case
-pencil
-tape
-centimeter scale (T491-492)
-string

Note: See teacher's guide (T296) for directions on construction.

TEACHING SUGGESTIONS:

1. Introduce the lesson by writing the term pendulum on the chalkboard. Help the children with the pronunciation. Ask if anyone knows what a pendulum is. Explain that a pendulum is usually a string with a weight hanging on it and that a pendulum can swing back and forth. Show the children the kind of pendulum

they will be using. You may want to mention some examples of where a pendulum may be found in a home (in a clock, for example).

2. Review the concept of energy giver and energy receiver (energy goes from an energy giver to an energy receiver in an interaction). Remind the children of their study of energy givers and energy receivers in moving systems. Ask them to give examples, so you can be sure they recall and understand the concept. Also review the concept of variable (something in a system that can change).

3. Divide the class into pairs. Have the children turn to page 164 as you distribute the materials for Step A (filmstrip cases, string, and tape).

4. Have the children open their books to page 164. Hand up the directions for the pendulum (chart) on the board. Have the children take turns reading the directions. Demonstrate the procedure for knotting or taping the string. Make your model pendulum available for examination by the children. As the children construct their pendulums, move around the room providing help and making sure the strings are attached properly.

5. Pass out an index card and centimeter scale (Appendix 1). Have the children read the directions for these two things from the chart. Have the children put the materials together.

6. Distribute three pencils to each pair of children.

7. After making sure that the cards and scales are completed correctly, distribute more tape, and have the children set up the system on a table as shown under step C. If the pencils are sharpened, tell the children to turn the points to face the table tops rather than away from the table edges. This should prevent injury. Emphasize that when the children tie the pendulums to the pencils, the pendulums should hang so that they almost but do not quite touch the floor. Point out that after the centimeter scale is placed on the floor under the pendulum, the folded edge of the index card should be positioned to align with the "0" on the scale. The pendulum should then almost touch the fold, as shown in the photograph. You may want to have the children tape the centimeter scales to the floor to prevent them from shifting during experimentation. Check each group's set up before you allow the children to experiment with it.

8. Allow the children time to explore this system. Remind the children to release and not push the pendulum. After they have had time to explore, have the children look at page 165. Read the directions to the children. Tell the children to do step D and mark clearly their results on the centimeter scale. Instruct them to label the mark with the letter A.

9. Read the next set of directions to the children. Have them follow the directions and label that mark B.

10. Have the children discuss the answers to the numbered questions. Ask them to identify the energy giver and energy receiver in this moving system (the pendulum is the energy giver and the card is the energy receiver). Some children may name the hand (or person) as the energy giver and the pendulum as the energy receiver. This is also correct, but encourage them to think of the interaction between the pendulum and card instead, and then name the energy giver and energy receiver. Also ask the children to describe what happened in terms of variables (the variable they changed was how far they pulled the pendulum before releasing it).

11. Since the pendulums will be used again in this cluster, you may want the children to put their names on tape and affix it to the outside of the filmstrip cases. Have the pairs write the names of both partners on the index cards and on the back of the centimeter scales.

12. Collect the materials and save them for the next lesson. Leave the pendulums attached to the pencils, so the children only have to tape the pencils to the tables to set up the systems again.

DESIRED LEARNING OUTCOME: The children should be able to construct a moving system and demonstrate how to control the amount of energy transferred in the system.

****

DEVELOPMENT: Lesson Cluster 3B-2 Making Energy Changes
Page T-299/S-166 More and More Energy (30-40 min.)

PURPOSE: To develop the concept that manipulation of variables allows one to control the amount of energy transferred in a moving system.

ADVANCE PREPARATION: Materials
-textbook (optional)
-5-6 washers for each pair of children
-chart (transparency) with directions for experiments
-pendulum and card from previous lesson

Language Cards/Key Signs
a washer
a pendulum
energy
to control
energy
a variable

TEACHING SUGGESTIONS:

1. Ask the children to set up their pendulums as before. Write the word energy on the board. Tell the children that they will be learning about "more and more energy." Pass out the washers.

2. Tell the children they will be able to use the washers in their pendulum system. Do not give them specific directions on how to use the washers. Allow the children to experiment with their pendulum systems. Move around the room guiding the activity.

3. After the children have explored their new system, ask them to do the specific activities listed on page 166. The children can read the directions from the chart.

4. After the children have completed the tests, discuss the results, using the questions on page 166 as a guide. Discuss how changing the variables of distance and weight affect the amount of energy transferred.

DESIRED LEARNING OUTCOME: The children should be able to identify variables in a moving system and demonstrate how to control the amount of energy transferred by changing the variables.

****

DEVELOPMENT: Lesson Cluster 3B-2 Making Energy Changes
Page T-300/S-167 Target the Energy (35-40 min.)

PURPOSE: To provide practice in controlling energy transfer in order to control the outcome of an interaction.

ADVANCE PREPARATION: Materials
- a piece of construction paper and crayons for each child
- textbook
- pendulum set-up from previous lesson

Language Cards/Key Signs
a target
a variable

TEACHING SUGGESTIONS:

1. Again have the children get into pairs and set up their pendulum systems, Pass out the construction paper and crayons. Ask the children to look at page 167.

2. Read the text with the children. Have them make "Smirk," and put the picture into their pendulum system. Make sure that these items are correctly positioned.

3. Tell the children in each pair to take turns trying to hit Smirk's eye or nose with the card. Remind them to reposition the card on Smirk's mouth after each turn. Review the variables that can be changed to hit the target (how far pendulum is pulled back, weight of pendulum).

4. If any children are unsuccessful, you may want to give them some assistance by suggesting different ways to manipulate the pendulum.

5. Have the children discuss the questions on page 167.

6. Help the children see how the concept of energy control applies to everyday situations. (e.g., baseball player controlling energy transferred from bat to ball.) Ask the children to describe other examples.

7. This is the first lesson in the cluster that uses these materials. However, you may want to make the materials available for a few more days so that the children can experiment with them in their spare time.

DESIRED LEARNING OUTCOME: The children should be able to control the outcome of an interaction by controlling the amount of energy transferred.

****

APPLICATION: Lesson Cluster 3B-2 Making Energy Changes
Page T-301/S-168 Giving Energy (20-25 min.)

PURPOSE: To apply the children's knowledge of energy control to problem solving in relation to a moving system.

ADVANCE PREPARATION: Materials -textbook

Language Cards/Key Signs
a prize
a hammer

TEACHING SUGGESTIONS:

1. Begin the lesson by having the children look at page 168.
Ask them to tell you what they think is happening in the two pictures, and what is the difference between them. Explain the story about Alice.

2. Ask the children to identify the energy giver and energy receiver in this system (the energy giver is the hammer and the energy receiver is the ball). (A child would also be correct in naming Alice as an energy giver and the hammer as an energy receiver, in the swinging interaction.) Also ask the children to name the variable that changed in this system (the weight of the hammer).

3. Hold a discussion with the class based on the answers to the numbered questions on page 168. There are several possible answers to question 2. Alice was able to ring the bell by using the heavier hammer, but she may have hit the platform harder or held the hammer farther back before she hit, as well. These are all variables in the system. Ask the children to compare this system and its variables to the pendulum system of the previous lesson.

DESIRED LEARNING OUTCOME: The children should be able to describe the solution to a problem in terms of methods of controlling the amount of energy transferred in a moving system.

****

EVALUATION: Lesson Cluster 3B-2 Making Energy Changes
Page T-302/S-169 Energy Control (20-25 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:

1. Identifying differences in the amount of energy transferred in a system.
2. Describing how energy transfer may be controlled in a system.

ADVANCE PREPARATION: Materials -copy of chart from page 169 on board (ransparency)
-student answer sheet for the three questions
Reword the questions according to the language level of the students.

TEACHING SUGGESTIONS:

1. Begin by telling the children that they will be reviewing what they learned about controlling energy.

2. Discuss the chart on the board. Explain that this was done in another class. Pass out the student answer sheets.

3. Ask each question. Give the children time to fill in the answer before going on to the next question.

4. When the children have finished, collect their papers and discuss their answers.

5. If a child correctly answers the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Unit 3 Interaction and Energy

Part B Energy, Lesson Cluster 3B-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-308	Introduction	The Millie McPherson System	35-40 min.
T-310	Development	Willy's System	25-40 min.
T-313	Enrichment	Don't Break the Chain	20-25 min.
T-314	Evaluation	Complete the Chain	15-20 min.

NOTE: Lesson 3 Energy Chain Mural, has been omitted.
Enrichment lesson, Don't Break the Chain, is included in the cluster.

B. MATERIALS: See the list on page T-305
Since Energy Chain Mural has been omitted the following materials are no longer needed.

poster paper
small jars
brown wrapping paper
scissors
tape
newspapers
paint brushes
rags
paper towels

FILMSTRIP INFORMATION: Filmstrip Set VIII. Moving and Mixing, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3B-3 Energy Chains
Page T-308/S-170 The Millie McPherson System (35-40 min.)

PURPOSE: To introduce the idea that energy receivers become energy givers in a system containing several linked interactions.

ADVANCE PREPARATION: Materials - small cards ready 5-6 of each saying "energy receiver", "an energy giver", pins (to pin to students)
cut out *pictures of items in Millie's system,
cut out arrows (that can be taped on board)
make transparency of page 170

Language Cards/Key Signs
a chute
a slide
to spill
to dump

Identification Cards

*These pictures can be made by making a transparency of the page, putting it on the board and having the picture on a piece of 8 x 11" paper.

Background Information - A system may have a series of connecting interactions in which the energy received by an object in one interaction is passed on to an object in another interaction in the system. This makes the first object change from an energy receiver to an energy giver. In such a system, an object can be part of more than one interaction. The "Rube Goldberg" set-ups illustrated in this cluster are amusing examples of this idea.

TEACHING SUGGESTIONS:

1. Write the words 'an energy giver' and 'an energy receiver' on the board. Ask the children what the terms mean.

2. Ask the children to line up across the front of the room shoulder to shoulder. Have the small cards and pins ready. Explain to the children that they will be doing an experiment. Tell them that they will have to decide on who is the giver/receiver.

3. Stand next to the first person in the line. Nudge the person with your shoulder, so that person nudges the next in line, and so on. Ask the children if you were a giver or receiver. Pin the appropriate label on yourself.

4. Go through each person, guide the children to the conclusion that you can be an energy giver and receiver in the same system. Pin the labels on the children as you go along. Put the transparency on page 170 on the board.

5. Have the children look at page 170. Ask them what they think is happening in the picture. Read and explain the story about Millie and using the transparency when talking about the system, remind the children that it can have more than one interaction. Explain all new vocabulary words to the children.

6. Have the children describe each part of the system and how it effects the rest part, e.g. the bird hit the ball. Write these sentences on the board. Review the interactions again to ensure that all the children understand how the system works.

7. Take out the cutouts of Millie's system. Put the clock and ball on the board. Ask the children what the interaction is between the two objects. Add the arrow to the previous object. Ask which is the energy giver and which is the energy receiver. Write the words below the appropriate pictures.

8. Then put the picture of the dog on the board. Again ask about the interaction and add the arrow. Then ask about the energy giver, receiver. Write these on the board, under the appropriate picture. Continue this until you have gone through the entire system.

9. Emphasize that the energy receiver in the first interaction is also the energy giver in the second interaction. Make sure that everyone understands this before concluding the lesson.

10. Have the children answer the questions on page 171. Repeat question #2, substituting the following words for ball: dog, string, water, repeat #2 substituting clock for for Millie.

11. Use the cutouts and arrows (with labels) as a bulletin board to be referred to in the next lesson.

DESIRED LEARNING OUTCOME: The children should be able to describe the transfer of energy through several linked interactions and identify energy receivers that become energy givers in the system.

* * *

DEVELOPMENT: Lesson Cluster 3B-3 Energy Chains
Page T-310/S-172 Willy's System (25-40 min.)

PURPOSE: To introduce the concept of an energy chain as a system in which energy receivers become energy givers.

ADVANCE PREPARATION: Materials - Cut out pictures of Willie's system, arrows, energy-labels, energy giver/energy receiver labels
transparency of page 172
student worksheet (energy chain for Millie's system

Language Cards/Key Signs
an energy chain

Identification Cards

Background Information - An energy chain is a system made up of a series of interactions in which the energy receiver in one interaction becomes the energy giver in the next one. Willy's system is similar to Millie McPherson's system of the previous lesson in that both systems are examples of energy chains. Energy chains can be diagrammed to show the flow of energy from one object to another. The objects are shown connected by arrows that indicate energy transfer.

TEACHING SUGGESTIONS:

1. Have the children look at page 310. Put the transparency on the board. First ask them what they think is happening in Willie's System. Then explain the system to them.

2. Ask the children to explain the system, object by object. Have them develop a sentence for each interaction, e.g. Willie throws the ball. Write these on the board.

3. As in the previous lesson, use the cut out pictures. Begin with Willie and the ball. Ask the children where to place the arrow, and who is the energy giver/receiver. Write those terms under these the appropriate picture. Continue this through the whole system.

4. Have the children look at page 173. Ask them to complete Willie's drawing. Discuss their answers.

5. Have the children look at the picture at the bottom of page 173. Write the term Energy Chain above the pictures on the board. Tell the children that an energy-chain diagram helps you trace the movement of energy from one object to another in a system. Explain that these arrows represent the energy. Write the word energy under each arrow. (At the completion of the lesson, those materials can be placed on a bulletin board.)

6. Ask the children the questions on page 173. Discuss their answers.

7. You can extend this lesson and further reinforce the concept of energy chain by applying to Millie's system in the previous lesson. Pass out the student worksheet. On the worksheet have a list and/or pictures of the objects in Millie's system. Ask the children to put the objects in order, and to make an energy chain, using arrows.

DESIRED LEARNING OUTCOME: The children should be able to identify functions of objects in an energy chain, label a system as an energy chain, and draw that system.

****

ENRICHMENT: Lesson Cluster 3B-3 Energy Chains
Page T-313 Don't Break the Chain (20-25 min.)

PURPOSE: To provide further practice in constructing energy chains derived from the children's imagination. This lesson does not appear in the student text.

ADVANCE PREPARATION: NONE.

Language Cards/Key Signs
a chain

Identification Cards

TEACHING SUGGESTIONS

1. (Last sentence should be: Write the energy chain, as it is created, and the interactions on the board.)

2. No modification.

3. Each child in turn must add to the chain, describing an interaction and identifying the energy giver and energy receiver. The children may be as fanciful or as serious as they like.

4. When the story gets back to the first person, he or she must think of a way to end the chain.

5. After a chain has been completed, read through the chain and the interactions. An eager or artistic child might offer to draw the energy chain at home to hang in the classroom for everyone to see.

DESIRED LEARNING OUTCOME: The children should be able to construct an energy chain and identify the energy receivers that become energy givers.

* * *

EVALUATION: Lesson Cluster 3B-3 Energy Chains
Page T-314/S-175 Complete the Chain (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives: 1. Completing an unfinished energy chain. 2. Identifying the objectives in a system that change from energy receivers to energy givers.

ADVANCE PREPARATION:

1. Student answersheet See following example.
2. Textbook.

Student Answersheet
An Energy Chain

a window
a dog

a bone
rope

Make an energy chain:

_____ → _____ → _____ → _____

List the energy givers:
1.
2.
3.

List the energy receivers:
1.
2.
3.

TEACHING SUGGESTIONS:

1. Have the children look at the energy system on page 175. Discuss the system if there are any questions.

2. Pass out the student answersheet. Explain it to the children. Ask them to work on it independently. Move among the children to give assistance.

3. When the children have completed their papers, discuss their answers.

4. If a child correctly completes this paper, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the rest cluster.

* * *

Level 3 Unit 3 Interaction and Energy

Part C Looking for Energy, Lesson Cluster 3C-1

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-320	Introduction	The Popcorn System	35-40 min.
T-323	Development	How Many Trips	25-30 min.
T-322	Development	Variables in the System	35-40 min.
T-324	Application	Using Gas Movers	20-25 min.
T-325	Evaluation	Find the Energy Givers	15-20 min.

B. MATERIALS LIST: Add the following to the materials list on T-317:
- small aquarium
- heavy object
- balloons
- string

FILMSTRIP INFORMATION: Filmstrip Set VIII, Moving and Mixing, is appropriate for use in this cluster.

INTRODUCTION: Lesson Cluster 3C-1 Finding Energy Givers
Page T-320/S-176 The Popcorn System (35-40 min.)

PURPOSE: To introduce the concept that gas bubbles may be an energy giver and to provide practice in identifying the energy giver and energy receiver in a moving system.

ADVANCE PREPARATION:

Language Cards/Key Signs
baking soda
vinegar
a spoon
popcorn
to rise
a gas
bubbles
a system

Background Information: In this lesson, the children will experiment with a system made up of baking soda, vinegar, and unpopped popcorn. When these ingredients are combined, chemical and physical reactions occur that cause the popcorn to rise and fall in the liquid. When baking soda is mixed with an acid, such as vinegar, carbon dioxide is formed. The gas appears as bubbles, which attach to the popcorn kernels. Since the gas-kernel system is lighter than water, the kernels rise to the surface. There the bubbles escape and the kernels sink to the bottom.

Other heavy objects, such as shelled peanuts or rice grains, may also be tested. Some objects may be so heavy that no amount of bubble formation will cause them to rise. Other may simply float on the surface and never drop to the bottom of the cup.

Materials -Have the following for each pair of students:
-plastic cup half full of water
-another cup one-quarter full of vinegar
-third cup one-quarter full of baking soda
-2 measuring spoons
-5-7 kernels of unpopped popcorn, rice, shelled peanuts or other objects (plus one tray of materials for demonstration)**
-chart with directions for experiment as follows:
-pictures of energy forms from Introduction Lesson B-1

The Popcorn System*

1. Take the cup of water.
2. Add one teaspoon (5 mL) of vinegar.
3. Drop the popcorn into the cup.
4. Slowly add one teaspoon (5 mL) of baking soda.
5. Observe what happens.

*Modify language depending on level of students.

**It would be a good idea to try out the system yourself before using it in class.

TEACHING SUGGESTIONS:

1. Take out the pictures of forms of energy studies in Cluster B-1 (motion, heat, light, sound, magnetic, electric energy). Discuss these with the class. Then have the children turn to page 176, and look at the picture. Ask them to try and name the energy form on that system (light energy). Tell the children that the energy giver is not shown in the picture, and that energy givers are sometimes hard to find in systems.

2. Have the children look at page 177. At the same time, take out the materials for the experiment and put the chart upon the board. Ask the children what they think will happen.

3. Tell the children that they will set up a moving system called the popcorn system. In this system they will have to find the energy giver. Challenge the children to be good detectives and observe the system carefully to discover the energy giver.

4. Use your demonstration tray. Ask the children to identify each item, providing the word if it is not known. List the materials on the board.

5. Have the children take turns reading the directions for the experiment. Demonstrate what to do, without really doing the experiment.

6. Divide the children into pairs and pass out the materials. Have them do the experiment. Move among the children, helping when necessary. Tell the children to observe the interaction.

7. Ask the children to describe what they see. Tell them that the bubbles are a kind of gas, and review the concept of gas.

8. As a group, answer the questions on page 177. Discuss the results of their experiments.

9. To extend this lesson, let the children experiment with the other items on their trays. Discuss what happens.

DESIRED LEARNING OUTCOME: The children should be able to set up and experiment with a moving system and identify the energy giver and energy receiver in the system.

* * *

DEVELOPMENT: Lesson Cluster 3C-1 Finding Energy Givers
Page T-323/S-179 How Many Trips (25-30 min.)

PURPOSE: To further develop the concept that gas bubbles may be an energy giver in a moving system and to provide practice in observing their effect.

PREREQUISITES: Counting movements, marking on a paper.

ADVANCE PREPARATION: Materials
- same materials as introduction
- only one kernel of popcorn and no other objects (rice, etc.) plus paper
- textbook (optional)
- chart (from previous lesson) modified to fit this lesson

Language Cards/Key Signs
a trip
vinegar
baking soda
a spoon
a kernel of popcorn
a variable

TEACHING SUGGESTIONS:

1. Pass out the materials and a piece of paper to pairs of students. Have the students read the directions again, noting the changes in the experiment.

2. Tell the students that they will not change any variables but keep them exactly the same as the last experiment.

3. When all of the systems are set up and the kernels are moving, you may be the time keeper, telling the pairs when to start counting and where to stop. Have one child put in the baking soda and the other make marks on paper, to count the trips. Have them total the marks at the end. Watch the children for accurate counting.

4. At the conclusion of the experiment, write the results of each team on the board. Compare the answers. Ask the children to account for difference between the teams. Their explanations might include: size of kernels are different, children may have added baking soda differently, or the counter could have made a mistake.

DESIRED LEARNING OUTCOME: The children should be able to describe the effect of an energy giver in a moving system.

* * *

DEVELOPMENT: Lesson Cluster 3C-1 Finding Energy Givers
Page T-322/S-178 Variables in the System (35-40 min.)

PURPOSE: To provide practice in controlling the time an interation takes by manipulating the variables in a moving system.

ADVANCE PREPARATION: Materials
- same as for Lesson II (make sure each pair is given one corn kernel)
- recording sheet as follows:

Language Cards/Key Signs
a larger time
variables

The Popcorn System

Variables	First System (no change)			
How many times did the popcorn move?				

-transparency of recording sheet

TEACHING SUGGESTIONS:

1. Using the demonstration tray, mix the popcorn system as in Lesson 1. Tell the children to count how many trips the popcorn makes. Have the children look at page 178.

2. Explain the test from that page. Discuss the concept of variables. Ask them what the variables are in this system.

3. Put the recording sheet on the board. Fill in the variables as they are given by the class. Have one pair volunteer to try each system.

4. Pass out the materials and the recording sheet. Have the students copy the variables from the board. Have them mix their popcorn systems and count the trips of the popcorn kernel.

5. When all the children have completed their part of the experiment, ask for their data and put it on the recording sheet. The students can then copy this onto their sheet.

6. Discuss the results of the experiment, by answering the questions on page 178.

DESIRED LEARNING OUTCOME: The children should be able to describe how to control the time an interaction takes by changing variables.

****

APPLICATION: Lesson Cluster 3C-1 Finding Energy Givers
Page T-324/S-180 Using Gas Movers (20-25 min.)

PURPOSE: To provide practice in identifying gas as an energy giver and to apply the concept to a new situation.

ADVANCE PREPARATION:

Background information: The picture on page 180 shows the use of a set of lightweight salvage bags designed to recover small ships from the ocean floor. The bags are deflated when they are attached to the ship and then pumped full of air. As they expand, they push (displace) water out of the way. When the weight of the water displaced exceeds the weight of the ship, the ship rises to the surface. The force that pushes the ship upward is called buoyancy. Most children at this level probably would not understand

Language Cards/Key Signs
an air bag
a ship
the surface of the water

the concept of buoyancy, but they probably have a feel for it from their experiences with bathtub and beach toys. Because the addition of air to the bags causes the ship to float, the air functions as the energy giver.

Materials -a small aquarium filled with water
-a heavy object
-four balloons blown up slightly and tied in pairs with string (this system should lift the object out of the water. Test it before using it.)

TEACHING SUGGESTIONS:

1. Set up the system in front of the class. Tell them that the object is treasure in the bottom of the ocean. Ask if they know how to get the treasure out. Then use the balloons - attached to the object, to raise it up. Discuss the energy giver/receiver.

2. Have the children look at page 180. Explain that the bags surrounding the ship are attached to it and filled with air. Remind the children, as they saw previously, that air is a gas and is lighter than water. The air bags float, and pull the ship up to the surface. Have the children answer the questions.

3. Ask the children to compare the airbag/ship system to the popcorn system of the previous lessons. They should realize that these moving systems are similar. In the popcorn system, the bubbles of gas moved the popcorn kernels up to the surface of the liquid.

4. Have the children discuss other moving systems that have gas as the energy giver (blimps, balloons, sailboats, kites, windmills, weather vanes, blowing leaves, blowing curtains, and other objects blowing in the wind).

5. Delete.

DESIRED LEARNING OUTCOME: The children should be able to identify gas as an energy giver in a moving system.

****

EVALUATION: Lesson Cluster 3C-1 Finding Energy Givers
Page T-325/S-181 Find the Energy Givers (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:
1. Identifying gas as the energy giver in a moving system.
2. Identifying energy giver and energy receiver in a moving system.
3. Identifying variable in a moving system.

ADVANCE PREPARATION: Materials -student answer sheets

Language Cards/Key Signs
gas
a pinwheel
vinegar
baking soda
popcorn kernels
variables

TEACHING SUGGESTIONS:

1. Have the children look at page 181. Have them name the objects pictured there and the objects in the popcorn system.

2. Ask the questions and have the children write their answers on the answer sheet.

3. When the children have finished, collect their papers and discuss the answers with them.

4. If a child correctly answers most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 3 Interaction and Energy

Part C Looking for Energy, Lesson Cluster 3C-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-330	Introduction	What Makes It Move?	35-40 min.
T-332	Development	Which Place?	25-30 min.
T-334	Development	Which Way?	25-35 min.
T-338	Evaluation	Find the Pointers	15-20 min.

B. MATERIALS: See Materials List on page T-327.

FILMSTRIP INFORMATION: Filmstrip Set VIII, Moving and Mixing, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3C-2 Mystery Movers
Page T-330/S-182 What Makes it Move? (35-40 min.)

PURPOSE: To introduce the concept that heat energy can make certain objects move and that the sun or a light can be a heat source.

ADVANCE PREPARATION: Materials
- chart with directions for making and using the paper pointer (in language appropriate to your students)
- scissors
- index cards (unlined)
- tape for each pair of students
- a light or sunny location

Language Cards/Key Signs
a paper pointer
a card
aluminum foil
straight
energy transfer
to bend
heat

Identification Cards

The inner foil liners from certain food packages, such as those containing powdered milk, toaster pastries, cereals, and breakfast drinks, are made of aluminum foil bonded to paper. Collect enough liners so that each pair of children will have one pointer measuring about 2cm by 10 cm (3/4 in. by 4 in.). Wrappers from gum, cigarette, or candy packages will not work because the foil and paper are not completely bonded, and the wrappers are too flimsy. Since each pair of children will need two pointers later in this cluster and existing ones may wear out, be sure to have extra foil liners on hand.

You can make the pointers ahead of time according to the photograph on page 182. Or you can cut the liners into premeasured strips and allow the children to make their own pointers. It would be a good idea to make a model of the pointer and experiment with it before class.

Background Information - In this lesson the children will see evidence of energy transfer, but the energy giver and the form of energy involved will not be obvious at first. The children work with a pointer made of aluminum foil bonded to paper and attached to a support (index card). The pointer responds to temperature change by bending when heated and straightening when cooled. This occurs because the aluminum side expands more than the paper side when heated, causing the pointer to bend. When placed in or removed from the sunlight, therefore, the pointer should move (in response to temperature changes, not light changes). This lesson should be done on a sunny day, since the pointer is designed to respond to the heat of the sun. However, it will also work if placed within 30 cm (1 ft.) of an incandescent (not fluorescent) lamp.

Not only does the aluminum foil side expand when the pointer gets hot, the paper side may expand due to absorption of water. So the pointer may move in response to changes in humidity, as well. Therefore, you may expect unusual results on some occasions.

TEACHING SUGGESTIONS:

1. At the beginning of the lesson, review the terms: energy, a moving system, an energy giver and an energy receiver.

2. Have the children look at page 182-183. Display your model of the pointer and put the chart with directions on the board.

3. Have the children take turns reading the directions. Refer to the model as the directions are read. Discuss all new vocabulary.

4. Pass out the materials to each pair of children. Have them construct the pointers, helping them when necessary. Tell the children that the line they make (with black crayons) on the card under the pointer will serve as a reference mark that they can use to compare positions of the pointer.

5. The last direction on the chart should be for the children to place their pointers in a sunny location and tape them there. Have the children do this.

6. Tell the children that they are experimenting with an energy giver and a form of energy that is not obvious at first. Ask someone to predict what will happen.

7. Write the term 'energy transfer' on the board. Explain the term to the children. Tell the children that they will be able to see energy transfer in their system.

8. Allow the pairs to observe their pointers several times. Tell them to use a pencil to mark the position of the pointer on the card at different times.

9. At the end of the day, or during the next morning, have the children compare their results. Then have them discuss the numbered questions on page 183. They may not yet realize that heat makes the pointer move.

DESIRED LEARNING OUTCOME: The children should be able to describe the responses of a paper pointer when it is placed in sunlight or near a light.

****

DEVELOPMENT: Lesson Cluster 3C-2 Mystery Movers
Page T-332/S-183 Which Place (25-30 min.)

PURPOSE: To develop the concept that the sun or a light can be a source of heat energy and that heat energy can make certain objects move.

ADVANCE PREPARATION: Materials

- teach lesson on sunny day or use a light
- additional foil liners from food packages if pointers from lesson (1) are worn out, and cut the premeasured strips
- copies of the pointer position forms (Appendix J), one for each student
- pointer diagram on board or transparency
- paper pointers from previous lesson

Language Cards/Key Signs
a different place
by a door
under a light
in the dark
near a window
in the sunshine
heat
(Could be done first in a language lesson)

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the children that they will investigate responses of their paper pointers in different locations.

2. Arrange the children in pairs. Distribute the pointer set-ups from the previous lesson. If the paper pointers are worn out, distribute the materials and have the children make new ones and attach them to the index cards.

3. Have the children look at page 184. Read the text with them, explaining anything they do not understand. Explain that the pictures represent overhead views of the index cards that support the paper pointers. Each diagram shows the line the children made under the end of the pointer as a reference mark. The pointers are omitted on these diagrams to indicate that they must be drawn by the children (on their own copies), to show their positions. The labels on the pointer tell where the children should place their pointer set-ups.

4. Explain that each pair will place their pointer in a different place. Your model could be used if necessary. Remind the children to tape down their pointers.

5. While the children are waiting for the pointers to respond, distribute the copies of Appendix J. Demonstrate how to mark the pointer using the model diagram on the chalkboard.

6. Allow at least ten minutes for the pointers to respond before the children examine them. If there is no change in the pointers after ten minutes, you may want the children to leave them in place longer.

7. When the pointers are ready, have the children examine pointers in each of the five locations and draw the pointers on the corresponding diagrams on their papers. Each child should complete all five diagrams.

8. Have the children compare their observations and discuss the answers to the numbered questions on page 184. You may wish to summarize the results by combining the class observations onto five diagrams on the chalkboard.

9. The pointer should have moved most when the set-up was placed in direct sunlight. However, wind or drafts from an open window or door may cause the pointer to move dramatically. To keep the emphasis on temperature-related movement, ask the children in which location the pointer would move if there were no air movement.

10. A comparison of the children's results should clarify the primary cause of the pointer's movement (heat energy). If they understand this, ask them to name the energy giver and energy receiver in the system (energy giver - the sun or light; energy receiver - the pointer). If the children still do not realize that heat makes the pointer move, they will have more opportunities later in this cluster.

11. This activity may raise questions concerning how heat makes the pointer move. Encourage the children to hypothesize answers to these questions. Tell them that further investigation through activities in this cluster may provide some answers.

DESIRED LEARNING OUTCOME: The children should be able to describe the locations in which a paper pointer moves and tell how they are different from locations in which it does not move.

****

DEVELOPMENT: Lesson Cluster 3C-2 Mystery Movers
Page T-334/S-185 Which Way (25-35 min.)

PURPOSE: To develop the concept that heating an object may cause movement and that the position of the object can affect the direction of the movement.

ADVANCE PREPARATION: Materials - materials to make:
- paper pointers, one set for each pair of students (additional pointers will be necessary)
- a light or a sunny location
- chart with directions for making the other pointers
- models of the two pointer systems

Language Cards/Key Signs
aluminum foil
a pointer
heat
place (position)

Identification Cards

TEACHING SUGGESTIONS:

1. Have the children look at page 185. Display the models of the two different systems. Put up the chart with directions.

2. Have the children take turns reading the directions for making the other pointer. Show your model as the pointer is discussed. Have the children compare the two systems.

3. Pass out the first pointer system and materials to make the second system. Have the pairs of children make the additional pointers following the directions on the chart. Give assistance where necessary.

4. As stated in the last direction of the chart, have the children place their pointers under a light or in a sunny location. Make sure they tape the pointer to the surface.

5. Wait ten minutes before the children examine the pointers. If necessary, allow extra tape for the pointers to respond. When the pointers are ready, have the children check them and mark the positions on the cards.

6. Have the children discuss the answers to the questions on page 185. They should begin to realize that the aluminum has special properties that cause it to respond to heat differently from the paper. Some children may want to know more about how the pointer moved. (See Background Information: T-330, T-334).

DESIRED LEARNING OUTCOME: The children should be able to describe the effect of position on the direction of movement of a paper pointer.

****

EVALUATION: Lesson Cluster 3C-2 Mystery Movers
Page T-338/S-188 Find the Pointers (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:

1. Describing evidence of energy transfer in a system.
2. Identifying heat as the form of energy involved in the interaction.
3. Identifying the sun and a light as heat sources and thus energy givers in the systems.

ADVANCE PREPARATION: Materials - textbook
- student answersheet

TEACHING SUGGESTIONS:

1. Begin the lesson by having the children look at page 188. Explain that the pictures are similar to those on 184. They represent overhead views of pointer setups and include the paper pointers (shown in red). Point out the labels under the pictures and explain that they tell where each set up was located when it was drawn.

2. Pass out the student answersheet. Ask each question, changing the language if necessary. Have the students answer each question on their answersheet.

3. To make sure that the children fully understand the idea of motion caused by heat energy and what the energy givers are, ask them to tell how they know energy is involved in the system, to name the energy giver in each picture, and to describe what kind of energy makes the pointers move. (The movement of the pointers shows that energy is transferred. The energy givers are as follows: top picture - light or bulb; second picture - none; third picture - the sun; bottom picture - the sun. Heat energy makes the pointers move. The energy givers are all sources of heat.)

4. When the children have finished, collect their papers and discuss the answers with them.

5. If a child correctly answers most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Unit 3 Interaction and Energy

Part C Looking for Energy, Lesson Cluster 3C-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-344	Introduction	Light Is Energy	30-35 min.
T-345	Development	Light and Color	15-20 min.
T-346	Development	Mirrors	30-35 min.
T-348	Development	Find the Changes	25-30 min.
T-350	Development	Light Stoppers	35-45 min.
T-351	Application	Using Light Energy	25-35 min.
T-352	Evaluation	All About Light	15-20 min.

B. MATERIALS: Add the following to the materials list on page T-341 -
- flashlights
- candle/matches
- lamp
- a solar cell

FILMSTRIP INFORMATION: Filmstrip Set VIII, Moving and Mixing is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3C-3 Light Energy
Page T-344/S-189 Light Is Energy (30-35 min.)

PURPOSE: To introduce the concept of light as a form of energy and to provide practice in identifying sources of light.

ADVANCE PREPARATION: Materials - pictures used in B-1 Introduction lesson
- flashlight
- candles and matches
- lamp
- title for bulletin board Light Energy (Note: this bulletin board will be developed and added to throughout the Cluster.)

Language Cards/Key Signs
a flashlight
a lamp
a candle
light energy

Identification Cards

Bulletin Board Section 1
Place the title at the top of the bulletin board. Have a student copy the list of objects from this lesson on a piece of paper. Make a subtitle Objects That Make Light - place this and the list on the bulletin board.

NOTE: Do not use the text on page 189. Use the picture only.

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Background Information - Light is a form of energy. Light is both absorbed and reflected by an object. You can see only light that is reflected. Although light can be seen, the concept of light as energy may be difficult for some children. The lessons in this cluster should help them understand how light affects objects and people's perceptions of objects.

TEACHING SUGGESTIONS:

1. Display the pictures of forms of energy, for review. Ask the children which form is represented in each picture. Tell the children that the next lessons will be on light energy.

2. Place the objects noted in Advance Preparation on a table in front of the class. Have the children name the objects. Discuss each object and its energy form. Allow the children to turn the objects on/off. Light the candle for them.

3. Have them look at the picture on page 189. Ask the children to name the objects that produce light. Write the names of the objects on the board. Encourage the children to think of other objects which produce light, add them to the list.

4. Conclude the lesson by reminding the children that light is energy and without it they could not see.

DESIRED LEARNING OUTCOME: The children should be able to identify sources of light energy and explain how light energy enables people to see objects.

* * *

DEVELOPMENT: Lesson Cluster 3C-3 Light Energy
Page T-345/S-190 Light and Color (15-20 min.)

PURPOSE: To develop the concept of absorption and reflection of difference colors of light by objects.

ADVANCE PREPARATION: Materials
- several prisms
- flashlight with spot bean or filmstrip projector
- piece of white construction paper
- piece of red, yellow, blue, green, orange, violet, black, colored paper
- colored chalk

Language Cards/Key Signs
a prism
an energy giver
an energy receiver
to absorb
to reflect

Identification Cards

TEACHING SUGGESTIONS:

1. Display the prisms on a table. Ask the children if they know what they are for. Tell them that they will find out something about light.

2. Take out the filmstrip projector and/or flashlight. Pass out the prisms. Turn the most of the lights out in the room. Let the children use the prisms. Give assistance when necessary. It may be necessary for you to adjust the distances between the light source and prism and paper before the color image is in focus.

3. When the children have seen the spectrum, turn on the lights. Have them list the colors, in order. Write them on the board. Explain to the children that light is made up of these colors. Then ask, why don't we see all of the colors when we look at objects.

4. Have the children look at page 190. Read the first paragraph to the class. Then show them a piece of red paper. Ask them why they see the paper as red. Remind them that light is made of many colors. If they develop a correct response, discuss it. If not, then explain that some colors go into the paper and some come back out of it to our eyes.

5. To make this concept clearer, use the colored chalk on the board. Show that the spectrum of colors goes to the red paper, but only the red color is reflected. Write the words absorbed and reflected on the board, and explain them as you draw the picture.

6. Hold up a piece of blue paper. Ask why we see blue. Discuss their answers. Make sure they name all of the absorbed colors. Encourage them to use the proper words (absorb/reflect). Do this with several other pieces of paper. Have them identify the energy giver/receiver.

7. Show the class a piece of black paper and white paper. Ask why they see black/white. Discuss their answers. Ask the children why dark colored clothes are warmer on a sunny day than light colored clothes.

8. Discuss the questions on page 190.

9. Bulletin Board - Section 2. Have a child color a picture of the spectrum and label the colors. Place this sentence below the picture. Light is made of many colors.

DESIRED LEARNING OUTCOME: The children should be able to explain the terms absorbed and reflected and describe colors objects absorb and reflect.

****

DEVELOPMENT: Lesson Cluster 3C-3 Light Energy
Page T-356/S-191 Mirrors (30-35 min.)

PURPOSE: To develop the concept that mirrors reflect light energy in a way that images can be seen and to provide practice in identifying other objects that also reflect images.

ADVANCE PREPARATION: Materials - flexible mirrors (or heavy-duty aluminum foil) one for each student
- magnifier
- bulletin board - place a small mirror on the bulletin board. Display the subtitle Mirrors Reflect Light above the mirror.

Language Cards/Key Signs
a mirror
(an image)*
to reflect
to absorb

*Depending on language level of students.
Identification Cards

Background Information - Objects with very shiny smooth surfaces, such as mirrors, pools of still water, and polished metals, reflect images when they reflect light. If a surface is rough or even slightly textured (as seen through a magnifier) it does not reflect an image. Instead, the color, shape, and texture of the surface is seen. Surfaces that seem smooth, such as a sheet of paper, do not reflect images because the surface is not smooth at all when examined through a magnifier.

A smooth surface must also be flat for an undistorted image to be seen. Reflections from "fun house" mirrors and curved shiny objects, such as polished spoons, are distorted because the surfaces are curved, not flat.

If your children used Level 2 of this program, they studied properties of surfaces (in Unit 2). If not, you may wish to introduce the concept that surfaces can be rough or smooth.

TEACHING SUGGESTIONS:

1. Arrange the children in pairs and give each pair a magnifier, a sheet of unlined white paper, and two mirrors. Review the terms reflected and absorbed.

2. Ask the children what they have recently learned about white objects and light energy (white objects reflect most of the light energy that strikes them). Write this on the chalkboard. Then ask the children what they know about mirrors and light energy from the previous lesson (Mirrors reflect most of the light energy that strikes them.) Write this on the chalkboard, also.

3. Ask the children what property white objects and mirrors have in common (both mirrors and white objects reflect most of the light that strikes them). Tell them that they will now learn why they see an image when they look in a mirror and why the do not see one when they look at a piece of white paper.

4. Remind the children that last year they may have studied surfaces. One property of surfaces is that they may be rough or smooth. Point out that sometimes a surface appears smooth, but when it is examined through a magnifier bumps and ridges can be seen.

5. Tell the children to look at the surfaces of the mirror and white sheet of paper (through the magnifier) and decide whether they are rough or smooth (The mirror has a smooth surface; the paper has a rough surface.) Summarize by writing on the chalkboard another property of surfaces: Smooth surfaces reflect images rough surfaces may reflect light but do not reflect images.

6. Have the children open to page 191. Have them read the directions for the mirror experiment. Have them work with the mirrors as instructed. Provide assistance as necessary.

7. Discuss the children's observations with them. Ask them what their reflections in the mirrors indicate (the mirror has a smooth surface and reflects almost all the light energy that strikes it). Then ask the children to explain what happens to light energy when they use two mirrors to look at their backs. (Light energy is reflected from a child's back to the mirror behind the child. It is then reflected from this mirror to the mirror in front of the child.

8. Have the children read the next set of directions. (With assistance) Have them follow the directions. Tell them not to bend the mirrors too much.

9. Ask what happened when the children bent the mirrors in and out (The images appeared distorted.). Ask if anyone can explain the distorted image. (A smooth surface must be completely flat for an undistorted image to be seen.) Collect all mirrors.

10. Discuss other objects that are like mirrors. Have the children look at the picture. Discuss the idea of reflection. Have the children answer the question.

11. Conclude the lesson by asking the children to explain how the mirrors in a "fun house" work. (They are curved in many ways so the images appear distorted.)

DESIRED LEARNING OUTCOME: The children should be able to identify and explain properties of mirrors and other objects that reflect images.

****

DEVELOPMENT: Lesson Cluster 3C-3 Light Energy
Page T-348/S-192 Find the Changes (25-30 min.)

PURPOSE: To develop the concept that a flat mirror reflects an image that is identical, but is the reverse of the actual object.

ADVANCE PREPARATION: Materials - Take the words from page 192 (and other words) and write them on cards. Make one set for each pair of students.
- paper (unlined)
- bulletin board - Section 4 Have a sentence written in "mirror writing" - have a title, "Can you read this?" Have a mirror near the bulletin board.

Language Cards/Key Signs
a mirror
symmetrical

Identification Cards

TEACHING SUGGESTIONS:

1. Ask the children to sit in pairs. Pass out a set of cards and two mirrors to each child. Ask them to look at the words using the mirror. Do not tell them what they will find. While the children are working, encourage them to classify the words that are the same and different when seen in a mirror.

2. Have the children look at page 192. They will notice that the words are similar. Discuss what they have found. List on the board, in two columns, the words that were the same and those that were different.

3. Encourage them to make a generalization about flat mirrors. (A flat mirror reflects the reverse image.)

4. As suggested in question 4, encourage the children to experiment with other words to try to find some that look the same in a mirror. Distribute paper, pencils, and rulers. Have the children write the words in large capital letters on a sheet of unlined paper and draw a line above each word. Provide help in choosing words, as necessary. Some that look the same in a mirror are BOX, BIKE, BOB, DOCK, BIB, DECK, OX, BED, KICK, DICK, CHICK, CHECK, HI, CODE, and OK.

5. You may wish to review (or introduce) the concept of symmetry as an extension of the questions. Point out that symmetrical objects look the same in a mirror.

6. You may want to further extend this lesson by suggesting that the children place the mirrors to the sides of capital letters they have written, and discuss the results. Ask them to find letters that look the same in the mirror from this angle (A, H, I, M, O, T, U, V, W, X, Y). Ask which ones look the same when a mirror placed above them, but not to the side (B, C, D, E, K). The children should realize that objects may be symmetrical in different ways.

7. For interested children, you may want to suggest that they write messages that can be introduced only by placing the mirror next to them. Provide examples (The sentences and letters should be written backwards). These messages can be placed on the bulletin board.

DESIRED LEARNING OUTCOME: The children should be able to explain the differences between an object and its image reflected in the mirror.

****

DEVELOPMENT: Lesson Cluster 3C-3 Light Energy
Page T-350/S-194 Light Stoppers (35-45 min.)

PURPOSE: To develop the concept that light energy can pass through certain objects and not others.

ADVANCE PREPARATION: Materials -

Language Cards/Key Signs
(those objects used in lesson.)
to pass through

Identification Cards

Prepare 12 pieces of cardboard (2 for each group of 5 children), 23 cm by 30.5 cm (9 in. by 12 in.). Use thin, sturdy cardboard. Cut a small, vertical opening, 1 cm by 3 cm (0.4 in. by 1.2 in.) in the center of 6 pieces. Obtain 12 soft wooden blocks, 23 cm by 7.6 cm by 5.x cm (9 in. by 3 in. by 2 in.), to serve as stands for the pieces of cardboard. Tack the edge of each piece to a wooden block as shown on page 194. Set up the solid cardboard and the cardboard with the hole for each group as shown. The solid cardboard serves as a screen, while the piece with the hole narrows the light to a small beam. The flashlight should be held so that its light shines through the opening onto the screen.

Gather a variety of objects as suggested on page 194. You might want to include some that will produce interesting patterns, such as old lace, doilies, or other fabrics.

Draw a chart on the chalkboard with three columns containing the headings Object, Lets Light Through, Does Not Let Light Through, for use during the lesson.

In addition to the above you will need - bulletin board section
- student worksheet - copy of the chart, one for each child
- change: make one set of materials for each pair of students

Bulletin Board - Section 6
Have a child copy the chart on "Objects That Let Light Through" and "Objects That Do Not." Label each list and place on blackboard. Display apparatus and materials on a table under the bulletin board.

TEACHING SUGGESTIONS:

1. Display the objects that will be used for the lesson. Have the children name each object. Point to the word on the chart as it is named. Explain the other headings on the chart.

2. Set up one set of equipment. Show the children how to use the set up. Explain that they must place a check in the appropriate box on their chart.

3. Pass out the materials. Have the children set them up. Check each pair of children. Pass out all of the test materials.

4. Darken the room and demonstrate how to shine light through the hole onto the screen, and how to test the objects. Have the children record their results on their papers.

5. Have the children discuss their observations by answering the numbered questions on page 194. You may wish to summarize their results on the chalkboard.

DESIRED LEARNING OUTCOME: The children should be able to identify objects that allow light energy to pass through and objects that do not.

* * *

APPLICATION: Lesson Cluster 3C-3 Light Energy
Page T-351/S-195 Using Light Energy (25-35 min.)

PURPOSE: To apply the concept of light energy to practical uses of light.

ADVANCE PREPARATION: Materials
- variety of magazines
- catalogues and newspapers that contain various uses of light
- find out whether there are any buildings with solar heating in the vacinity of your school
- scissors for each child
- Bulletin Board (see #5)
- a solar cell connected to something (optional)

Language Cards/Key Signs
solar energy

Identification Cards

TEACHING SUGGESTIONS:

1. Pass out the magazines and newspapers. Tell the children that they are to find uses of light. Before they start to look for pictures, have each child name one use. Give assistance while they are working. Include magazines with pictures about solar energy. If the students do not cut them out, then you do, and explain them to the class.

2. Have each child show and explain his or her pictures to the class you explain any pictures you have found.

3. Have the children look at page 195. Discuss each picture. Write the words solar energy on the board. Discuss the concept. Show the students the solar cell if you can get one. Show them how the object works on solar energy.

4. If there are any buildings with solar heating in the neighborhood, mention this to the children. You may want to take them to see the buildings. Have the children observe other uses of light as they walk there.

5. Place their pictures on the bulletin board under the subtitle "Uses of Light Energy."

DESIRED LEARNING OUTCOME: The children should be able to describe several practical uses of light energy.

****

EVALUATION: Lesson Cluster 3C-3 Light Energy
Page T-352/S-196 All About Light (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:

1. Identifying the colors of light that an object absorbs and reflects.
2. Describing reflections in mirrors.

ADVANCE PREPARATION: Materials - textbook
- mirrors for each student
- student answersheet

TEACHING SUGGESTIONS:

1. Pass out the mirrors and answer sheets. Have the students look at page 196.

2. Read each question to the class. Have them write their answers on the answersheet.

3. When all of the children have completed their work, discuss their answers.

4. If a child correctly answers the questions correctly, you may assume that he/she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

5. As a final review of the cluster, discuss each section of the bulletin board.

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Level 3 Unit 4 Population Interaction

Part A Interactions Within a Population, Lesson Cluster 4A-1

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-362	Introduction	Interacting Organisms	20-35 min.
T-363	Development	Helpful Interactions	20-25 min.
T-365	Development	Some Animals Fight	20-30 min.
T-366	Development	Animals on the Move	20-25 min.
T-368	Application	People on the Move	15-20 min.
T-369	Evaluation	Many Interactions	15-20 min.

B. MATERIALS: Add the following to the Materials list on page T-359:
- pictures of various animals (interacting, fighting, migrating)
- teacher-made map of North America

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction in a Population, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4A-1 Interactions
Page T-362/S-199 Interacting Organisms (20-25 min.)

PURPOSE: To introduce the term organism and the concept of interaction between organisms.

PREREQUISITES: Observation of interacting organisms.

ADVANCE PREPARATION:

Background Information: Interaction has previously been defined as what happens when objects do something to each other, or the action that produces change in one or more objects. In this unit the definition is expanded to apply to living objects. Organisms interact both when they do something to each other and when they do something together (cooperate). Cooperation usually involves communication, often without physical contact between organisms. Communication is considered a part of interaction. Interaction between organisms may produce change in one or more of them, but often it does not.

The term organism usually includes microorganisms in addition to plants and animals. However, the definition on page 199 is simplified for the children.

Language Cards/Key Signs
organism
a plant
an animal
interaction

Identification Cards
an organism
a plant
an animal

Materials -Begin this unit by visiting a zoo or pet store, or both. Have the students observe the interactions between animals and record them by taking a photograph or by writing down information.
-Have various pictures of organisms interacting. Mount these on heavy cardboard. These could be displayed at the completion of the lesson.

TEACHING SUGGESTIONS:

NOTE: Before this unit is begun, take a trip as stated above or bring organisms into the classroom for the students to observe. Choose a few representative organisms to study. Begin to make a mural with a picture of each organism. As this cluster is continued, this chart will also be developed.

CHART (Mural)
(A-1)

Organisms			

1. Write the word interaction on the board. Show the students pictures of interacting organisms. Have them discuss how these animals are interacting. Relate these pictures to the trip or animals observed previously.
2. Have the students look at page 199. Write the word organism on the board. Explain its meaning. Ask the students if they can point to the organisms on that page, and in some of the pictures which you have shown.
3. Read and explain the text to the students. Ask the question at the end of the page.
4. Review the concepts of interaction and organisms.
5. Display the pictures and vocabulary used on a bulletin board.
6. Place certain organisms on the large mural (chart) and discuss them.

DESIRED LEARNING OUTCOME: The children should be able to explain the term organism and describe examples of interation between organisms.

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DEVELOPMENT: Lesson Cluster 4A-1 Interactions
Page T-363/S-200 Helpful Interactions (20-25 min.)

PURPOSE: To introduce the concept of population and to develop the concept of interaction between members of one population, using examples of cooperation (helpful interaction).

PREREQUISITES: Previous experience observing interactions between pets or animals in the classroom.

ADVANCE PREPARATION:

Background Information: If your children used Level 2 of this program, they studied the concept of population (in Unit 4). If not, you should spend some time teaching this concept, as it is essential that the children fully understand it before they attempt the lessons in the rest of this unit.

A population is a group of organisms of the same species (kind) living in the same place. When naming population, particular kinds must be stated, rather than categories. For example, it is incorrect to say "the population of trees in the park" because there may be more than one kind of tree there. One must instead refer to the "population of sugar maples" or the "population of red oaks."

Interaction within a population consists of any interaction between members of the same population. This cluster introduces various animal behaviors as examples of this concept. Interactions within plant populations are not covered in Part A because they are too complex for children at this level.

Interaction between animals in a population are usually helpful in that they contribute toward the health and safety of the participants, the production of healthy offspring, and the learning of survival skills by young animals. The interactions studied in Part A usually contribute toward the survival of populations (species) as groups.

The term helpful interactions in this lesson refers to peaceful, cooperative behaviors that may occur among members of a population. Cooperative behavior usually permits a population to perform necessary functions that may not be possible for any one member to accomplish alone. For example, helpful (cooperative) interactions enable some animals to maintain healthy skin (grooming interactions), to secure appropriate shelter (home-building interactions), to obtain food (group-hunting interactions), to produce offspring (ritualized courtship behaviors), to care for young (parent-offspring interactions), and to avoid enemies (giving warning signals).

Aggressive interactions (the opposite of cooperative behaviors) are covered in the next lesson. Aggression, too, can be helpful for the survival of the individual (keeping or seizing a feeding territory, for example) and for the survival of the species (protecting the young, for example).

Materials -Collect a variety of pictures of populations of organisms. Mount these on heavy cardboard, to be displayed at the completion of the lesson.
-Place the word populations on the chart, and find pictures of populations on these representative organisms.
-A transparency or chart with the title Population of Organisms.

Language Cards/Key Signs
a population
helpful ways
to play
to clean

TEACHING SUGGESTIONS:

1. Begin the lesson by showing the pictures of various populations. Ask the students what is the same in each picture. (The type of organisms are the same.)

2. Write the word population on the board. Ask the students if they know what that word means. Explain the word to the students, using the pictures to reinforce what is being said.

3. Emphasize that a population is a group of the same kind of organisms living in the same place. Ask the students to list some examples of populations. Write these on the transparency. Make sure they list kinds rather than categories (for example, 'mosquitoes' rather than insects). Encourage the students to name plant populations as well as animal populations.

4. Have the students look at page 200. Write the title of the lesson on the board. Ask the students how these organisms are helping each other.

5. Read and explain the text to the students. Ask the questions at the bottom of the page. Discuss their answers. Encourage the students to think in terms of helpful human interactions as well as interactions among other animals. Examples might include interactions between doctor and patient, teacher and students, etc.

6. Display the pictures used in the lesson, with a title of Populations of Organisms. The information on the transparency could also be copied on a piece of chart paper and displayed in the classroom.

7. Place the pictures of the representative populations on the mural and discuss them with the class.

DESIRED LEARNING OUTCOME: The children should be able to explain the term population and describe helpful (cooperative) interactions between members of a population.

****

DEVELOPMENT: Lesson Cluster 4A-1 Interactions
Page T-365/S-201 Some Animals Fight (20-30 min.)

PURPOSE: To develop the concept of interaction between members of one population by studying aggressive interactions.

PREREQUISITES: Observation of animals fighting, either pets, classroom animals or animals at the zoo.

ADVANCE PREPARATION:

Language Cards/Key Signs
to fight
to harm
a sea gull
a stickleback
fighting

Background Information: Sometimes members of a population, who may show cooperative behavior in many ways, appear to fight. These aggressive interactions are usually associated with territoriality (protection of mating, nesting, and feeding territories) and social hierarchy (dominance). Dogs guard their territories from other dogs, mice protect their litters from other mice, and chickens have a pecking order.

Many aggressive interactions between members of a population appear to be fights when in actuality they are only threatening movements. These ritualized interactions usually intimidate one opponent into fleeing. Threatening movements enable an animal to try to get what it wants (or keep what it has) often without actually fighting or risking physical injury. However, the children may have observed fights in domestic animals, such as dogs and cats, that have resulted in injury. Any aggressive interaction is referred to as "fighting" in this lesson, to simplify the concept.

The fish shown on page 201 are sticklebacks. Unlike other fish species that leave the hatching of their eggs to chance, the male stickleback builds a nest in the sand and cares for the eggs and, later, the young. He drives off all intruders, including other sticklebacks (even the mother), until the young fish can survive on their own.

Materials -Collect pictures of animals fighting. Mount these on heavy cardboard.
-Continue the chart by adding the title Fighting. Find pictures to include or have the students draw pictures.

TEACHING SUGGESTIONS:

1. Show the students pictures of the animals fighting. Ask the students what is happening in the pictures. Also ask them why they think it is happening.

2. Have the students look at page 201. Read the text to them and explain as you go along. Tell them the names for the organisms in the pictures. Write these names on the board.

3. Have the students observe the pictures and describe what they see.

4. Ask the questions at the bottom of the page. Discuss their answers.

5. Discuss the fighting behavior of the organisms that you have listed on the chart. If no pictures are available of fighting behavior, have the students draw pictures for the chart.

DESIRED LEARNING OUTCOME: The children should be able to identify fighting interactions within a population and reasons why animals fight.

* * *

DEVELOPMENT: Lesson Cluster 4A-1 Interactions
Page T-366/S-202 Animals on the Move (20-25 min.)

PURPOSE: To further develop the concept of interaction within a population by studying migration in different populations.

ADVANCE PREPARATION:

Background Information: The periodic movement of a population back and forth between one place and another is called migration. Many familiar migratory patterns occur twice a year and appear to be seasonal, changing with temperature and light conditions. Migratory birds are familiar examples. They leave an area and return at predictable times. Other examples of migration occur in Alaskan fur seals, sea turtles, eels, salmon and other fish, and many insects (such as monarch butterflies).

Migration helps populations survive by allowing them to move to areas of good food supply, and by allowing them to move to the best areas for breeding and raising young.

Migration is an interaction between members of a population in which they communicate and cooperate (do something together) without doing something to each other.

Materials -Have a large map of North America to display in the room. It would be best to make your own map, without any labels, and then place the labels on the map as the lesson progresses.
-Collect pictures of animals that migrate. Mount these on heavy cardboard.
-Make cutouts of reindeer and whales that can be placed on the map during the lesson.
-Using a ditto, make copies of the map, two for each student.

Language Cards/Key Signs
spring
winter
fall
summer
to migrate
a group
a population
a place
Canada
a reindeer
a whale
North America
California
Alaska
a forest
a coast

Identification Cards
Canada
North America
California
an ocean
a coast
(These labels will be used on a map.)

TEACHING SUGGESTIONS:

1. Ask the students if they know what happens to some animals in the winter time. Ask them if they see various birds, etc. during the winter months. Discuss the possible reasons for their disappearance.

2. Have the students look at pages 202-203. Write the words "move - migration" on the board. Also display the map of North America.

3. Read through the text with the students. Explain each concept as they occur. When talking about each place on the map, place the appropriate label on it. After you have explained about the reindeer, have a student take a reindeer cutout and show the movement.

4. Read through the information about the whale. Label the map and have the students show the movement of the whales, using the cutouts.

5. Have the students answer the questions on page 233. Discuss their answers.

6. To review the map, remove all of the labels and have the students replace them. Also have them place the cutouts of the animals on the map for one season and then the other.

7. Pass out the ditto copy of the maps, two to each student. Ask them to label one summer and one winter. Then ask them to draw the positions of the two animals during these seasons. They can also label the areas on the map.

DESIRED LEARNING OUTCOME: The children should be able to explain that some populations interact by moving in groups and describe how this helps the populations survive.

****

APPLICATION: Lesson Cluster 4A-1 Interactions
Page T-368/S-204 People on the Move (15-20 min.)

PURPOSE: To apply to people the concept of migration as an interaction between members of one population.

PREREQUISITES: Use of the map of North America, and study about Eskimos.

ADVANCE PREPARATION:

Background Information: Despite harsh conditions, Eskimos live in the northern-most part of North America. They survive in the severe environment by hunting animals that supply them with food, fuel, clothing, and tools. The Eskimos move in response to the migratory patterns of the animals they depend on. In winter, when the reindeer migrate south from the tundra to the forests, the Eskimos travel from the tundra to the far north to hunt walruses and seals that migrate there. In spring, the reindeer go back north to the tundra and the Eskimos move back south to the tundra to hunt them.

Other groups of people who move in response to food supply are the Bedouins, who travel in the desert, and shepherds, who alternate between high mountain pastures in summer and warmer lowlands in winter. Other people move in different seasons for economic reasons. Migrant farm workers in the United States, for example, move where the crops are in season. In India and Pakistan, a peasant may migrate to the city to work, leaving the family in the village. Periodically, the peasant returns to the village with money and goods. Families in North America often move when a parent is transferred or gets a job in another city.

Language Cards/Key Signs
an Eskimo
a seal
a walrus
a reindeer

Identification Cards
Alaska
Canada
the Pacific Ocean
the Arctic Ocean
Hudson Bay

Materials -Use the same map as in the previous lesson, but remove the labels and animals.
-Ditto maps of North America for the student, two each.
-Cutout pictures of seals, walruses, and Eskimos.

TEACHING SUGGESTIONS:

1. Have the students look at page 204. Display the map and hàve the labels and cutouts ready.

2. Read the text to the students. Use the map and labels to explain as you go through the information.

3. Ask the students to place the cutout pictures on the map first for summer, then for winter.

4. Remove the labels from the map and have the students put them on again.

5. Ask one student to explain the migration of the Eskimos, another the walrus, another the reindeer.

6. Pass out the ditto maps, two to each student. Ask them to label one summer and one winter. Have them draw the positions of the Eskimos, seals, walruses, and reindeer. Have them label these and label the parts of the map.

DESIRED LEARNING OUTCOME: The children should be able to describe an example of human migration and explain reasons people migrate.

****

EVALUATION: Lesson Cluster 4A-1 Interactions
Page T-369/S-205 Many Interactions (15-20 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:
1. Describing evidence of interaction between organisms in a population.
2. Identifying ways animals in a population interact.

ADVANCE PREPARATION: Materials -make student answer sheets

Language Cards/Key Signs
cleaning
fighting
playing
interacting

TEACHING SUGGESTIONS:

1. Have the students look at page 205. Discuss the names of the animals in each picture. Review the vocabulary.

2. Pass out the answer sheet to each student. Ask each question, paraphrasing where necessary, and have them write their answers on the answer sheet.

3. When the students have completed their answers, discuss them.

4. You may wish to ask the children to describe other examples of interaction within a population, such as feeding, cleaning, or migrating.

5. If a child correctly answers all of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Part A Interactions Within a Population, Lesson Cluster 4A-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-375	Development	A Mouse Home	40-45 min.
T-374	Introduction	Animals That Build Homes	20-25 min.
T-380	Application	People Build Homes	25-30 min.
T-381	Evaluation	Building Homes	15-20 min.

NOTE: The first lesson is the development lesson, the introduction comes second. An Aunt Home has been omitted.

B. MATERIALS: Add the following to Materials List on page T-371
- pictures of animals homes and people homes

DEVELOPMENT: Lesson Cluster 4A-2 Home-Building Interactions
Page T-375/S-207 A Mouse Home (40-45 min.)

PURPOSE: To develop the concept of home-building interactions through observation of nest building in mice. Lesson (2b) may be done instead of this lesson, or both may be done.

BACKGROUND INFORMATION:

Mice are active nest builders. If they are given suitable materials, they will build a nest, even if a pregnant female is not in the cage. Mice use their nests for sleeping, hiding, and raising young. Since mice like dark places for sleeping and hiding, they may take advantage of the inverted cardboard box and build their nest in it. If this happens, lift the box gently to observe the nest, being careful not to disturb it. Replace the box when observation is finished. Keep in mind that the nest, not the cage, is the "mouse home." The cage is the environment in which the mice build their home.

Mice are easy to care for but should be handled gently. The more they are handled, however, the tamer they become. The children should be taught correct handling and the proper way to approach the mice to avoid frightening them and to prevent being bitten.

Be sure to change the bedding (sawdust or shavings) and clean the cage regularly. Also change the play objects periodically for variety. Do not place the cage near drafts or in direct sunlight. Keep the food dish filled with more than the mice need. A mouse eats about 5 g (weighing 0.2 oz.) of food per day.

Keep a reference on hand for further information. Inexpensive guides for care of small animals can be found in most pet shops. Libraries also can provide good references. One excellent animal-care guide is Animal Care From Protozoa to Small Mammals by Barbara Orlans, Addison-Wesley, Menlo Park, California, 1977. You may wish to appoint a "Mouse Patrol" to take turns caring for the mice and post a schedule of duties for the children to follow.

Mice are curious and playful animals. They are sure to delight your children. At the end of the year, you will probably have several anxious volunteers to care for the class pets over the summer. Before you give the mice to children to take home, make sure that their interest in caring for them is genuine, that they have the proper equipment, that they have no cats at home, and that they have their parents' permission.

ADVANCE PREPARATION: Materials -

Note: Use all female or all male mice for the house.

1. See Teacher's Manual - Advance Preparation.
2. Make a chart with the labels listed under identification cards, and the objects listed. Make the labels removeable so that the students can place the label next to the appropriate object, as vocabulary practice.
3. Make a chart listing the steps in making a mouse home. Use language which your students can read.
4. Have a large sheet of chart paper ready.

*Display the objects to be included in the home.

Language Cards/Key Signs
a mouse
mice
cardboard
cotton
a home

Identification Cards
a mouse
cotton
a box
a stick
cedar chips
an exercise wheel

TEACHING SUGGESTIONS:

1. Display the mouse home on a table in front of the class.* Display the chart of the various objects. Have the labels ready. As you discuss each object, place the label next to it on the chart.

2. Ask the students to look at page 207. Display the chart listing the directions for making the mouse home. Have the students read the directions and do each thing.

3. Explain your rules for the care and handling of mice. Demonstrate the proper method for picking up a mouse and caution the children not to pick one up unless it is really necessary. You may want to post your rules in the room or write them on the chalkboard as a reminder. Place the mice in the cage and have the children observe their behavior as the mice explore their new environment.

4. Explain to the students that they will be observing the mouse home every day and that they will be writing down what they see.

5. Take the large sheet of chart paper and write these titles: Interactions With Objects, Changes in Cage, and Food Eaten. Each day, observe the mouse home and ask the students to note the changes. Then you write these changes on the chart, dating each entry.

6. After about a week, have the children discuss the answers to the questions, using the observations recorded on the large chart.

7. Ask the children to name other animals which build homes. This will lead into the next lesson.

DESIRED LEARNING OUTCOME: The children should be able to describe home building and other interactions in a population of mice.

****

INTRODUCTION: Lesson Cluster 4A-2 Home-Building Interactions
Page T-374/S-206 Animals That Build Homes (20-25 min.)

PURPOSE: To further develop the concept that animals build homes.

ADVANCE PREPARATION: Materials -

1. Display the mouse home, to be referred to during the lesson.
2. Collect pictures of animals and their homes.
3. Continue the mural started in Cluster A-1 by adding the title Homes and adding pictures of homes of the representative organisms.

Language Cards/Key Signs
an object
building a home
a beaver
a gannet
a home

Identification Cards

TEACHING SUGGESTIONS:

1. Show the students pictures of animals and their homes. Discuss each picture with the students, placing special emphasis on the materials of the homes.

2. Have the students look at page 206. Read the text to them and explain it.

3. After you explain that the animals interact with objects, return to the pictures shown previously and ask the students which objects each animal used.

4. On the board, make a list of the animals and the objects interacted with.

5. Discuss the pictures on page 206 in the same way. Use the questions as a guide for discussion.

DESIRED LEARNING OUTCOME: The children should be able to name objects that animals interact with when building their homes.

* * *

APPLICATION: Lesson Cluster 4A-2 Home-Building Interactions
Page T-380/S-210 People Build Homes (25-30 min.)

PURPOSE: To apply to people the concept of home-building interactions.

PREREQUISITES: Study of homes, possibly during a Social Studies Lesson.

ADVANCE PREPARATION: Materials -

1. Collect pictures of a wide variety of homes. Mount them on heavy cardboard. Label each picture.
2. Prepare a bulletin board with the title Home Building Interactions. The pictures of animal and people homes will be placed here after the lesson is completed.

Language Cards/Key Signs
a farm house
an apartment
an adobe pueblo

Identification Cards
(Labels for homes in
pictures you have
collected

TEACHING SUGGESTIONS:

1. Ask the students where people live. Show them the various pictures of people-homes. Discuss each one. Include in the discussion the objects that people interacted with to make the home.

2. Have the students look at page 210. Read the text to them. Discuss each picture and the questions on that page. Use the questions to stimulate class discussion of home building by people.

3. When the children consider different places where homes are found, emphasize that they should describe general geographic areas (the city, the suburbs, the country, the desert) rather than name specific places (New York Ontario, Arizona). Help the children determine the relationship between type of home and environment. For example, the availability of materials and technology in a particular area may be reflected in the kind of structure built there. Also, population density and other buildings may affect the type of home built.

4. Point out that unlike other animals, most people in developed countries do not build their own homes. Other people build the homes for them. In less developed areas, however, people often do build their own homes.

5. Have the children discuss the numbered questions.

6. Arrange the pictures from the lesson on the bulletin board.

DESIRED LEARNING OUTCOME: The children should be able to describe home-building interactions of people and kinds of homes people build.

****

EVALUATION: Lesson Cluster 4A-2 Home-Building Interactions
Page T-381/S-211 Building Homes (15-20 min.)

PURPOSE:
1. Identify homes built by certain animals.
2. Describe the objects that animals interact with to build the home.

ADVANCE PREPARATION: Materials -

1. Choose five pictures of animals and their homes used in the Introduction Lesson.
2. Make a student answersheet as follows:

	Organism	Home	Objects Used
1.			
2.			
3.			
4.			
5.			

Language Cards/Key Signs
(names of organism used in lesson)

Identification Cards

NOTE: Do not use the page from the textbook. These organisms were never discussed previously and thus would be confusing to the students. Use only those pictures on animals that have been used in previous lesson.

TEACHING SUGGESTIONS:

1. Pass out the student answersheet and explain how it is to be filled out.
2. Show each picture and have the students write their answers in the appropriate spaces. These five pictures can be displayed on the board. Write the name of the organism under the picture.
3. As the students are working, check their work and help with any vocabulary or spelling problems.
4. After the students have completed their work, take each picture and discuss the answers.

****

Level 3 Unit 4 Population Interaction

Part A Interactions Within a Population, Lesson Cluster 4A-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-387	Development	A Mouse Family	45-50 min.
T-386	Introduction	Caring for Young	20-25 min.
T-390	Development	On Their Own	20-25 min.
T-391	Application	Children's Needs	20-25 min.
T-393	Evaluation	Different Young Animals	20-25 min.

NOTE: The first lesson is the development lesson, the introduction comes second.

B. MATERIALS: See list on page T-383.

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction in a Population, is appropriate for use in this unit.

DEVELOPMENT: Lesson Cluster 4A-3 Young and Old Interact
Page T-387/S-213 A Mouse Family (45-50 min.)

PURPOSE: To develop the concept that some animals need care from their parents through observation of interactions between a mouse and her litter. Lesson (2b) may be done instead of this lesson, or both may be done.

ADVANCE PREPARATION:

Language Cards/Key Signs
- a litter
- a baby
- to nurse
- milk
- to mate
- male
- female

Background Information: The mother mouse will most likely build the nest within the inverted box (nest box) and give birth inside. In addition, the nest may be somewhat buried in the bedding. As a result, you may have to lift the nest box and even move aside bedding in order to see the litter and their interactions with the mother. (The nest box was removed in the photograph on page 213 to show the litter with the mother.) Try to do this with a minimum of disruption of the mother and her young, since they should not be disturbed for the first ten days. Always replace the nest box when observation is finished. The young should not be touched directly by anyone during this period, because the protective mother may bite someone or eat her young due to foreign odor on them. If the young must be handled later (to clean the cage) bedding should be rubbed on the hands to pick up the mother's scent and to avoid transferring human odor to the young.

An average mouse litter consists of six to nine babies that are born hairless, deaf, and blind. Record the birth date so you can keep track of their age. Hair begins to appear at about 3 days, hearing begins at about 11 days and the babies open their eyes and discover solid food at 14 days. The babies should be separated from their mother when they are three to four weeks old and the sexes should be separated to prevent breeding. In giving away the young mice, follow the listed precautions on page T-376. For further information on care and handling of mice and ways to determine sex, refer to an animal-care guide (available at pet stores and in libraries). An excellent one is Animal Care From Protozoa to Small Mammals by F. Barbara Orlans, Addison-Wesley, Menlo Park, California, 1977.

If mice are unavailable, you may use hamsters or other small rodents for this lesson.

Materials:

1. Four weeks previous to this lesson, purchase a male and a female mouse. (Not the same used on the mouse house.) Make a cage for them, as stated in the lesson on the mouse house. Keep them in the classroom, but do not make specific reference to them until the mouse house is developed. Then the students can also observe interactions in this second mouse house. Discuss the sex of the animals and mating behavior.
2. Modifications to mouse house for breeding - provide additional bedding, remove exercise wheels, provide extra greens, and milk-soaked bread to be continued when the mother is nursing. The gestation period is 22-29 days. Before the babies are born, the father should be removed from the cage.
3. Have a piece of chart paper ready.

TEACHING SUGGESTIONS:

1. Display the cage of mice on a table in front of the class. Explain the rules for observing the mouse and her litter and the reasons for the rules. You could post the rules in the classroom.

2. Have the students look at page 213. Read the text to the students. Explain to them what things they should be observing.

3. Take the chart paper. Write the following titles on it: Behavior of Mother and Young, Interactions, Food Eaten By Young. Explain to the class that they will be observing the mice each day. You will write down their observations on the chart, dating each entry.

4. After about four weeks of observation (when the litter is weaned) have the students discuss the questions on 213. Discuss the fact that mice are babies only for a short time, as compared with humans. You could also discuss the life span of the mouse.

5. Ask the children to predict what would happen if the mother mouse did not care for her young.

DESIRED LEARNING OUTCOME: The children should be able to explain that young mice need parental care and descrive how a mouse cares for her young.

****

INTRODUCTION: Lesson Cluster 4A-3 Young and Old Interact
Page T-386/S-212 Caring for Young (20-25 min.)

PURPOSE: To introduce the concept of caring for young as an example of interaction between members of a population.

PREREQUISITES: The ability to match an adult animal with its young.

ADVANCE PREPARATION:

Materials - 1. Collect pictures of animals with their young. Label the animals. Also write a sentence to go with each picture telling about one aspect of care, e.g. the mother is cleaning the baby's fur.

2. Paper, for the students to write sentences about the pictures.

Language Cards/Key Signs
to care for
to feed
to protect
a monkey
a raccoon
to carry
young

TEACHING SUGGESTIONS:

1. Have the students look at page 212. Read the text to them, explaining how animals care for their young. Point out that caring for young is an example of interaction within a population.

2. No modification.

3. No modification.

4. No modification.

5. Show the pictures of the animals with their young. Discuss each picture and how the adult is caring for the young.

6. Pass out paper to each student. Have the students choose one or two pictures. Ask them to write a sentence about each picture. Display these in the classroom when completed.

DESIRED LEARNING OUTCOME: The children should be able to explain how members of some populations care for their young.

****

DEVELOPMENT: Lesson Cluster 4A-3 Young and Old Interact
Page T-390/S-215 On Their Own (20-25 min.)

PURPOSE: To develop the concept that some animals are independent of their parents at birth.

PREREQUISITES: Experience with the development of frogs (egg, tadpole, frog).

ADVANCE PREPARATION:

Materials: 1. Collect pictures of animals that take care of themselves, and animals that need mothering. Mount these on heavy cardboard. These will be used for a bulletin board at the end of this lesson.

2. If possible, collect frog eggs, or start a population of mealworms.

3. Titles for the bulletin board, These Animals Need Parents, These Animals Do Not Need Parents. Place these on the bulletin board before the start of the lesson.

Language Cards/Key Signs
a tortoise
a tadpole
a frog
(any other names of animals used in lesson)
to take care of themselves

TEACHING SUGGESTIONS:

1. Have the students look at page 215. Read the text to them and explain the concept. Discuss each of the pictures.

2. Have the students answer the questions at the bottom of the page. Explain that many young animals need no parental help; they are able to move about, feed themselves and find a place to live as soon as they are born.

3. Have the students read the titles on the bulletin board. Show them the pictures of the animals. Have them label each animal and then place it in the appropriate place on the bulletin board. Discuss the behavior/abilities of each animal as they are placed on the board.

DESIRED LEARNING OUTCOME: The children should be able to describe some animals that are independent of their parents at birth and explain how they are able to survive on their own.

****

APPLICATION: Lesson Cluster 4A-3 Young and Old Interact
Page T-391/S-216 Children's Needs (20-25 min.)

PURPOSE: To apply to people the concept of caring for young as an interaction within a population.

ADVANCE PREPARATION: None.

Language Cards/Key Signs
a child
children

TEACHING SUGGESTIONS:

1. Have the students look at page 216. Read the text to them.

2. Have the children look at the photographs and discuss the interactions shown in each one.

3. Ask the children to suggest other examples of child-parent interaction and list them on the chalkboard.

4. Have the children discuss the answers to the numbered questions on page 216. Ask them what important skills their parents teach them. Make sure they understand that the teaching-learning process is also an interaction. Ask the children what else their parents give them that is important but cannot be seen or measured (love, affection, and attention are necessary for a child's healthy emotional growth).

5. You might want to point out that human parents care for their children for a longer time than any other animal. However, people usually give birth to only one offspring at a time, while other animals more often have multiple births. Also, people have a longer life span than most other animals.

DESIRED LEARNING OUTCOME: The children should be able to describe how human parents care for their children.

****

EVALUATION: Lesson Cluster 4A-3 Young and Old Interact
Page T-393/S-217 Different Young Animals (20-25 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:

1. Distinguishing between animals that need care from their parents and those that do not.
2. Describing how an animal interacts with its young.

ADVANCE PREPARATION:

Materials:

1. Remove ten pictures from the bulletin board of the last development lesson. Keep the labels on the pictures. Mix them up and tape them to the board.
2. Make a student answersheet. It should include the following: a. a chart for sorting animals into two groups, using titles from bulletin board; b. a list of four of the animals that interact with parents, with space for the student to explain how they interact.

TEACHING SUGGESTIONS:

NOTE: The textbook page should not be used for the evaluation. It could be used as a discussion to follow up the evaluation listed above.

1. Tape the pictures to the board. Pass out the answer sheets. Explain how they are to be filled out.
2. Help the students with any problems in answering the questions.
3. When all of the students have completed their answers, discuss them.
4. As a further follow up to this cluster, have the students look at page 217. They should discuss the pictures and answer the questions as a group..
5. If the student has correctly answered most of the questions, then you can assume that he or she has completed the objectives for the cluster.

****

Level 3 Unit 4 Population Interaction

Part B Two Populations Interact, Lesson Cluster 4B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-400	Introduction	Some Animals Eat Plants	20-25 min.
T-402	Development	Start an Aphid Population	60-75 min.
T-406	Application	Favorite Foods	50-60 min.
T-409	Evaluation	Park Interactions	20-25 min.

B. MATERIALS: See list on pages T-396-397.

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction in a Population is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4B-1 Plant-Eating Interactions
Page T-400/S-219 Some Animals Eat Plants (20-25 min.)

PURPOSE: To introduce the concept of eating as an interaction between two populations and to introduce the concept of plant eater.

ADVANCE PREPARATION:

Background Information: Eating is the most obvious and common form of interaction between populations. Many naimals eat only plants. These animals are known as herbivores. Some herbivores eat only particular plant parts or products, such as sap, stems, fruits, seeds, leaves, and roots, rather than whole plants. Many plant eaters are considered destructive and threaten crops, trees, and flowers. Potato beetles are one example. Other plant eaters are considered helpful. The bee, for example, pollinates flowers and makes honey.

Materials -Collect samples of organisms eating plants, such as worms on corn, caterpillars on leaves, etc., or collect pictures of these things.
-Make a display of the organisms/pictures in the class. The title for the display could be Do these organisms eat plants?

Language Cards/Key Signs
to eat
interaction
a population
a beetle
sheep
herbivore
an organism

Identification Cards
Labels for any organisms or pictures used in lesson

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students look at the picture on page 218. Discuss the fact that there are two populations there. Ask if the populations are interacting. Have the students describe the interaction. Explain that they will be

learning about populations interacting.

2. Have the students look at the organisms/pictures which you have on display in the classroom. Label each organism, and ask the students what they think it eats. Explain what they eat, and have the students look at the proof (holes in leaves, etc.).

3. Have the students look at page 219. Read the text to the students. Have them look at the two pictures and discuss what is happening in each.

4. Introduce the term herbivore to the students by writing it on the board and explaining it to them. Encourage them to use it in their discussions.

5. Have the students answer the questions on the bottom of the page. Emphasize that these animals eat only plants, but may eat more than one kind of plant.

6. Turn to pages 222-223. Have the students look at the pictures on these pages. Discuss each picture, what the organism is and what it is eating. Ask the students to name other organisms that they know eat plants.

DESIRED LEARNING OUTCOME: The children should be able to explain the term plant eater and describe animals that are plant eaters and their food.

****

DEVELOPMENT: Lesson Cluster 4B-1 Plant Eating Interactions
Page T-402/S-220 Start an Aphid Population (60-75 min.)

PURPOSE: To develop the concept of a plant eater population and the effect it may have on a plant population, through observation of aphids and plants. Lesson (2b) may be done instead of this lesson, or both may be done.

PREREQUISITES: Exposure to the concept that plants make food in the leaves.

ADVANCE PREPARATION:

Background Information: Aphids have a complex life cycle consisting of four distinct forms. One or both types of adults, winged and wingless may be present on your plants, and it may be difficult for the children to distinguish between young aphids and wingless adults. Consequently, do not emphasize accurate and comprehensive identification of the aphid stages. Just make sure the children understand that there are different forms of aphids, so they can identify aphids on the plants.

There are thousands of varieties of aphids that range in color from brown to green to white. They may be smooth or woolly. As a result, your aphids may not exactly resemble those illustrated on pages 220 and 221. Aphids settle on plant stems and leaves and feed by sucking the plant juices from within rather than by chewing, as some other insects do. Aphids multiply rapidly if not controlled, and inflict severe damage to plants. Ideally, this lesson should result in diseased or dead plants and increased numbers of aphids, kept alive by the ample food supply. The initial symptoms of plant disease should be wilting of leaves and stems caused by loss of fluids. If you do not obtain the desired results with this activity, it is suggested that you complete Lesson (2b) in this cluster.

Language Cards/Key Signs
an aphid
a population
an experiment

Identification Cards
an aphid
an egg
a young aphid
a wingless adult
a winged adult

If you plan to do Lesson (2a), Aphids and Ladybugs, in Cluster B-2, you should save the aphid-infested plants for use in that Lesson.

Materials:
1. Obtain six plants infested with aphids. Use three plants for this lesson and save the other three for a lesson in B-2. There should be more than one plant in each pot to have a population. Put three stakes or dowels in each pot to support the cheesecloth without crushing the plants. Have ready anough cheesecloth to cover all six plants.
2. Have a hand lense for each student.
3. Make a bulletin board showing the four stages of the aphid. Copy the pictures from the book and label them.
4. You will need a piece of cheesecloth, three sticks and a rubberband for each pot.
5. Student worksheet (explained below).

TEACHING SUGGESTIONS:

1. Show the students the infested plants. Pass out the hand lenses. Ask them what they see on the plants. Tell them that the name of the organism is an aphid.

2. Have the students open their books to page 220. Explain to the students that the aphid goes through different stages. Discuss each stage from the pictures. Refer to the bulletin board.

3. Have the students look at the aphids on the plants. Ask them to describe the aphids. Write their descriptions on the board.

4. Have the students look at page 221. Explain that they will be doing an experiment. Explain the directions to the students. As you explain what should be done, write it on the board.

   1. Count the aphids.
   2. Write down the number and the date, etc.

5. Have the students work in pairs. Pass out the plants, materials and a piece of paper. The paper should have a heading: Date/Number of Aphids. Have the students count the aphids and write the information on the paper. Then have them follow the other directions, covering the plant. Use masking tape to label the pots with their names.

6. Allow time each week for the students to count their populations. They should record this information on their papers. These could be posted next to the plant. Suggest that the students look for signs of disease in the plants. Make sure they replace the cheesecloth each time.

7. When appropriate, have the students answer the questions on page 221.

DESIRED LEARNING OUTCOME: The children should be able to describe the effect of an aphid population on a plant population and identify different stages of aphid development.

****

APPLICATION: Lesson Cluster 4B-1 Plant-Eating Interactions
Page T-406/S-224 Favorite Foods (50-60 min.)

PURPOSE: To apply the concept of plant eater populations to the study of certain insects and their food preferences.

ADVANCE PREPARATION:

Language Cards/Key Signs

- a grasshopper
- a cricket
- a caterpillar
- a beetle
- a terrarium
- a population
- a plant eater (Herbivore)
- favorite

Identification Cards

- a net
- a jar
- corn plant
- bean plant
- grass
- a radish plant
- seeds
- a terrarium

Background Information: This lesson provides the children with an opportunity to discover the food preferences of different herbivorous insects. Each insect population will be given the same set of plant populations to feed on. The children may observe different effects of the insects in the different terrariums. This is one form of evidence of the insects' food preferences. Or, the children may actually observe the insects feeding on particular plant populations.

As suggested in question 3 on page 225, however, some insects may not feed on any plants at all. You should be prepared for a possible high death rate among the insects, such as- some kinds of beetles, are carnivorous (they eat other insects), and will not eat plants. Some insects may prefer plants other than those you have provided.

Many herbivorous insects feed on a variety of plants. As a result, the children may not be able to detect special food preferences of insects that do eat plants and remain healthy. In addition, even if an insect prefers certain food, it may be difficult to observe exactly what it is eating.

If you do not obtain the desired results with this activity, for any of the reasons just mentioned, this lesson would make an excellent research project instead, with each group of children studying a different kind of insect. Encourage the children not to be disappointed by the results of their experiment. Use the opportunity to explain to the children that experiments do not always work.

If any of your insect populations consist of caterpillars, be aware that they will soon pupate and eventually become moths or butterflies. Watching the adults emerge is an exciting experience, but the adults will serve no use in this lesson. As soon as your caterpillars show signs of becoming inactive or begin spinning cocoons, you may wish to take them back outside. Cocoons do not eat or move around.

Materials - see teacher's manual advancer preparation.

TEACHING SUGGESTIONS:

1. Have the students look at page 224. Explain that they will be going out to find these organisms. (If you have already completed this, then skip to #6.)

2. If you have not stocked the terrarium with insects in advance, divide the class into four groups and assign each group a kind of insect to look for. (One kind must be crickets.) You may wish to vary the list of insects on page 224 to accommodate your geographical region.

3. Distribute the insect nets and plastic jars with lids.

4. Take the children outdoors to collect their insect specimens. Demonstrate the use of the insect net. (Once an insect is caught, the net should be turned over so the netting hangs over the rim and the insect is trapped inside.) Children without nets can try to catch insects directly with the jars and lids. Caution the children not to try to catch insects with their hands, as certain ones might sting or bite.

5. Return to the classroom. Have the class identify the insects. Show the students the four terrariums. Explain how they will be used. Identify the plants inside the terrariums. Label them. Tell the students that they will try and discover the favorite foods of each plant eater population.

6. No modification.

7. Pass out rulers. Have the students copy the chart from page 225. Explain how this chart will be filled in.

8. Have several students volunteer to observe each terrarium. Then as the data is collected, they can fill in the other sections of their chart. Have them observe the terrariums three times a week.

9. No modification.

10. After two weeks, have the groups compare their observations, using the information recorded in their charts. You may wish to summarize the results on the chalkboard. Then have the children discuss the answers to the numbered questions on page 225. Ask them how they could tell which plants were eaten, and whether the insects necessarily ate the plants that they crawled about on. Ask the children whether the sizes of the plant populations changed. If the sizes decreased, ask the children what this means for the plant eater populations (they may also eventually decrease in size due to diminished food supply).

11. Save the large terrarium containing circkets for use in the next cluster. Return all the other insects to their natural environment.

DESIRED LEARNING OUTCOME: The children should be able to collect and identify plant eating insect populations and describe each population's food preferences

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EVALUATION: Lesson Cluster 4B-1 Plant Eating Interactions
Page T-409/S-226 Park Interactions (20-25 min.)

PURPOSE: 1. Identify animals that are plant eaters.
2. Describe what these animals eat.

ADVANCE PREPARATION: Materials -paper and pencils

1. Prepare a student answer sheet for questions 1 and 2. The answer sheet should look like the following:

Plant Eater	Plants Eaten
1.	
2. etc.	

Language Cards/Key Signs
a bird
a squirrel
a caterpillar
a grasshopper

183

TEACHING SUGGESTIONS:

1. Have the students look at page 226. Name the organisms on the page. Write each name on the board.

2. Pass out the student answer sheet. Ask the students to look at the picture and fill in the chart.

3. While the students are wroking, move among them to help with vocabulary/ spelling problems.

4. When the students have completed their answers, discuss them.

5. Use question #3 as a class discussion question. This should not be used as part of the test.

6. If the students have correctly filled in the chart, you may assume that he or she has demonstrated the objectives for this cluster and is ready to go on to the next cluster.

7. Ask the children which animal shown is not a plant eater. Ask the children how they would classify these animals (animal eaters). Tell the children they will learn about animal eaters in the next cluster.

****

Level 3 Unit 4 Population Interaction

Part B Two Populations Interact, Lesson Cluster 4B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-416	Development	Aphids and Ladybugs	45-50 min.
T-414	Introduction	Some Animals Eat Animals	20-25 min.
T-419	Development	Plant-and-Animal Eaters	25-30 min.
T-420	Application	Add Animals Eaters	40-60 min.
T-423	Evaluation	Find the Animal Eaters	20-25 min.

NOTE: The first development lesson is done before the introduction.

B. MATERIALS: See list on page T-411.

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction in a Population, is appropriate for use in this unit.

DEVELOPMENT: Lesson Cluster 4B-2 Animal-Eating Interactions
Page T-416/S-228 Aphids and Ladybugs (45-50 min.)

PURPOSE: To develop the concept of an animal-eater population and the effect it may have on another animal population, through observation of aphids and ladybugs. Lesson (2b) may be done instead of this lesson, or both may be done.

ADVANCE PREPARATION:

Background Information - The ladybug is actually a ladybird beetle. The females lay their eggs in small clusters from which larvae emerge in about a week. The larvae molt several times before becoming pupae. From the pupa the last stage emerges - the adult ladybug. The entire process takes about three to four weeks. The children may observe some of the early life stages of ladybugs after adding adults to the plants.

There are several varieties of ladybugs: yours may not exactly resemble the one shown on page 229. Gardeners often introduce ladybugs into their gardens as a natural pest control, since the adults and larvae feed on aphids, spider mites, mealybugs, and other harmful insects. Ideally, during this lesson the children should notice a steady decline in the aphid population. However, this may not occur for a variety of reasons. You may have obtained a variety of ladybug that does not feed on aphids. Or, your aphids may reproduce at such a high rate during the observation period that no change or even an increase in the aphid population may be observed, even if the ladybugs do eat the aphids. If you do not obtain the desired results with this activity, it is suggested that you complete Lesson (2b) in this cluster.

Materials -

1. Use the three plants with aphids that were put aside from Cluster B-1. Ladybugs can be caught or ordered several weeks in advance from Mellingers, 2310 West South Range Road, North Lima, OH, 44520. Request a variety of ladybug that is known to feed on aphids.
2. Have a hand lense for each student.
3. Paper, pencils, and rulers should be available.
4. Write the chart (explained below) on a transparency.

Language Cards/Key Signs
an aphid
a ladybug
a population
to interact
to compare
number
a chart

Identification Cards
a chart
an aphid
a ladybug
cheesecloth

TEACHING SUGGESTIONS:

1. Place the plants (which were previously covered with cheesecloth) on the table in front of the classroom. (Note: these are not the plants used in the previous experiment, but the ones that were set aside.)

2. Ask the students about the aphid population on the plants. Tell them that they will be learning more about the aphid population.

3. Show the students the ladybugs. Ask them what they think would happen if the ladybugs were added to the aphid population.

4. Have the students group in pairs, with one plant for each pair. Give each group some ladybugs in a jar. Tell the students to first count the aphids on the plant and write the number on a piece of paper. Then tell them to add the ladybugs to the population, and using the hand lense, observe what happens.

5. Discuss what has happened between the aphids during that time. Then they will be writing the information on a chart. Place a transparency of the chart on the board. Ask the students to copy the chart on their paper. That day they should fill in the number of aphids on the plant. The chart should look as follows:

Date									
Number of Aphids									

6. Have the students count the aphids every two days, write in the date and the number of aphids. Also have the students record any interactions between aphids and ladybugs.

7. After two weeks, show the students the chart from page 229 (but revise it to look like their chart). This can be done on a transparency. Tell the students that these results were from another class. Ask them what the chart shows and why there is an increase of aphids at the end. Compare this chart to their charts.

8. Ask the students to look at page 229. Show them the picture of the ladybug and aphid. Ask them what is happening in the picture. Ask the students the questions on page 229. For question 3, explain that 'spray crops' means to use poisonous chemical sprays that kill pests. Explain why someone might not want to use chemicals.

DESIRED LEARNING OUTCOME: The children should be able to describe the effect of a ladybug population on an aphid population and state that animal eaters often feed on plant eaters.

****

INTRODUCTION: Lesson Cluster 4B-2 Animal-Eating Interactions
Page T-414/S-227 Some Animals Eat Animals (20-25 min.)

PURPOSE: To further develop the concept of animal eater as an extension of the concept of eating as an interaction between two populations.

ADVANCE PREPARATION:

Background Information - Many animals are carnivores - that is, they eat only other animals. The concept of carnivore is not limited to the eating of mammals, birds, and fish, as many people think. An animal that eats any other animal, whether it is an insect, worm, or snail, is an animal eater. This should be made clear to the children. It is not a good idea to use the term meat eater to mean animal eater, because the idea of "meat" usually limits one's thinking to mammals or birds, to the exclusion of other animal food.

Any animal that kills and eats other animals is called a predator. The animal that a predator kills and eats is called prey.

Materials -

1. Collect pictures of animals eating other animals. National Wildlife, Ranger Rick, or International Wildlife have excellent photographs. Mount the pictures on cardboard and label the animals in each picture.
2. Make letters for a bulletin board - Animal-Eating Interaction. At the completion of the lesson the pictures can be displayed on the board.
3. Chart paper with headings: Organisms Animals Eaten.

Language Cards/Key Signs
a starfish
a mussel
an owl
a mouse
(other animals used in lesson)
an animal eater

Identification Cards
(Labels for pictures of animals used in lesson)

TEACHING SUGGESTIONS:

1. Begin the lesson by asking the students if they know what kind of food an owl eats. Discuss the possibilities. Then show the students the collection of pictures, discussing each one and the animals involved in the interaction.
2. Ask the students if they can name other animals that are animals eaters. Write these on a piece of chart paper specified above.
3. Have the students look at page 227. Explain that these are some more examples of animal-eaters. Discuss the owl and what it is eating. Read the text to the students, explaining the concept of interaction. Refer to their experiment with the aphids/ladybugs.
4. At the end of the lesson, you could discuss animals that eat both plants and animals if the students have sufficient knowledge in this area.

5. Display the pictures used in the lesson and the chart on the previously prepared bulletin board.

DESIRED LEARNING OUTCOME: The students should be able to name animal eaters and the animals which they eat.

****

DEVELOPMENT: Lesson Cluster 4B-2 Animal-Eating Interactions
Page T-419/S-231 Plant-and-Animal Eaters (25-30 min.)

PURPOSE: To develop the concept of an animal that eats both plants and animals.

PREREQUISITES: Knowing where basic foods come from.

ADVANCE PREPARATION: Materials -

1. Collect pictures of animals that eat both plants and animals (e.g. cardinal, raccoon, baboon, bear, skunk).
2. Prepare a student worksheet with these titles: Foods I Ate   Plant or Animal

Language Cards/Key Signs
(Names of animals used in lesson)
a plant-and-animal eater
an omnivore

Identification Cards
(Labels for pictures used in lesson)

TEACHING SUGGESTIONS:

1. Explain to the students that some animals eat both plants and animals. Show them the pictures, and discuss the animals and their foods. Explain that these plant and animal eaters are also called omnivores. Write the word on the board.

2. Have the students look at page 231. Read the text to them and discuss it.

3. Have the students answer the numbered questions. When they get to the third question, pass out the student worksheet. Have them fill it in. Help the students with identification and spelling of items.

4. When the students have completed their papers, discuss their answers. Make two lists on the board of plant foods and animal foods. Have the students place their foods in the appropriate place. You could add a category to your list of 'both', for those foods that could be a combination.

DESIRED LEARNING OUTCOME: The children should be able to explain the term plant-and-animal eater and describe animals that eat both plants and animals and describe their food.

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APPLICATION: Lesson Cluster 4B-2 Animal-Eating Interactions
Page T-420/S-232 Add Animal Eaters (40-60 min.)

PURPOSE: To extend the concept that an animal-eater population may affect a plant-eater population to include the possible effect, in turn, on a plant population.

ADVANCE PREPARATION:

Background Information - The toads or chameleons are to be placed in Side A of the terrarium, the "experimental" side, to see their effect on the plant-eater (cricket) population and, ultimately, on the plant population. Side B is to be left unchanged as the "control" side, to show what happens when there are no animal eaters. Chameleons and toads readily feed on crickets. Ideally, the children should observe a decrease in the number of plant eaters (crickets) in Side A but little or no change in Side B. In addition, the children may eventually notice that the plants on Side A are healthier than those on Side B, due to the decrease in plant eaters. If you do not obtain the desired results with this lesson, discuss with the children what should have happened and the possible reasons why it did not happen.

Toads and chameleons should not be handled except when absolutely necessary. Never pick up a chameleon by the tail; the tail may break off or the skin may tear. Since toads secrete a fluid that irritates the eyes and lips, always wash your hands after handling toads.

Materials -

1. See teacher's manual advance preparation.
2. Have pictures of the toad, chameleon and cricket to be labeled and displayed near the terrarium.
3. Make a student answersheet (chart) similar to the one on page 233.

Language Cards/Key Signs
a toad
a chameleon
a cricket
an animal eater
an experiment

Identification Cards
a toad
a chameleon
a cricket

TEACHING SUGGESTIONS:

1. Display the terrarium in the front of the room. Show the students that the terrarium has been divided. Then bring out the animal eater population.

2. Ask the students what they think would happen if the animal were put into one side of the terrarium. Tell the students that they will find out by doing an experiment.

3. Pass out the answersheets and explain how they are to be filled out. Have the students count the crickets on each side and write the numbers on their papers.

4. Then place the animal eater in side A. Have the students observe the interaction for about five minutes. Then have them continue their observations as specified on the chart. Have them fill in the numbers each day that they observe.

5. At the end of one week, discuss the results of the experiment. Also have the students answer the numbered questions on page 233. For questions 1 and 2 the students should use the data from their charts. For questions 3 and 4 they should observe the terrarium directly. Ask the students to compare their results with the predictions made at the beginning of the week.

6. Emphasize that the animal eaters are eating plant eaters in this lesson. Help the children understand the effect that animal eaters may have on several populations - plant-eater populations and plant populations. (Plant-eater populations may decrease while plant populations may increase.) Discuss the idea of biological pest control through the use of natural predators. If you did Lesson (2a) in this cluster, remind the children of their discussion of this topic (question 3 on page 229).

Ask the children how toads and chameleons could be helpful to people (they help eliminate plant-eater nuisances). Ask what other animals help people (owls eat rodents, snakes eat rodents, birds eat insects, for example).

7. Release the crickets and toads to their natural environment and give away the chameleons to "good homes."

DESIRED LEARNING OUTCOME: The children should be able to describe the effect of an animal-eater population on a plant-eater population and on a plant population, and state why some animal-eating interactions are considered helpful by people.

****

EVALUATION: Lesson Cluster 4B-2 Animal-Eating Interactions
Page T-423/S-234 Finding the Animal-Eaters (20-25 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:

1. Identifying animals that are animal eaters.
2. Describing animal eaters' food preferences.
3. Identifying animals that eat both plants and animals.
4. Describing the effect of an animal eater population on a plant-eater population.

ADVANCE PREPARATION: Materials - 1. Prepare a student answersheet for the four questions.

TEACHING SUGGESTIONS:

1. Have the students look at page 234. Refer to each animal and to the name listed underneath.

2. Pass out the answersheets. Ask the questions and have the students write their answers on the answersheets.

3. When the students have completed their answers, discuss them.

4. If a student correctly answers the questions, you may assume that he or she has demonstrated the objectives for this cluster and is ready to go on to the next cluster.

5. For further informal evaluation, have the children turn back to page 218 and look at the picture that introduces Part B. Ask them why they think that particular picture was used to introduce this part. Suggest that they look for clues in the part title and in the cluster titles on pages 219 and 227. The children should be able to:
   a. state that the picture shows two interacting populations (brown pelicans and fish);
   b. describe how the populations are interacting (one eats the other);
   c. identify the kind of eating interaction shown (animal-eating or carnivorous);
   d. identify the animal eaters (pelicans) and their food (fish);
   e. describe how the pelican population might affect the fish population (cause it to decrease in size).

****

Level 3 Unit 4 Population Interaction

Part B Two Populations Interact, Lesson Cluster 4B-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-429	Introduction	What are Decomposers?	45-50 min.
T-430	Development	Underground	50-60 min.
T-432	Development	Kinds of Decomposers	35-45 min.
T-428	Introduction	Scavengers	15-20 min.
T-434	Application	Helpful and Harmful	25-35 min.
T-436	Evaluation	Dead Organisms Change	20-25 min.

NOTE: The order of the lessons has been changed.

B. MATERIALS: Add the following to the list on page T-425 -
- addition (for T-429) wood that is decomposing (various stages)
- leaves or other material that is decomposing (in various stages)

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interactions in a Population, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4B-3 After Organisms Die
Page T-429/S-236 What are Decomposers? (40-50 min.)

PURPOSE: To introduce the concept of decomposers and their actions.

ADVANCE PREPARATION:

Background Information: Decomposers are organisms that break down (decompose) dead plant or animal matter into simpler materials while they feed on it. They cause dead matter to decay (rot). Most decomposers are bacteria or funguses. Decomposers not only feed on bodies of dead organisms, they also feed on wastes and discarded parts of living organisms, such as feces, skin that was molted, lost feathers, and dead leaves.

Decomposers have an important function in the environment - they return essential minerals and elements to the soil, water, and air, which are then used by new plants and animals. Decomposers remove the bodies of dead organisms that would otherwise litter the ground and water.

Language Cards/Key Signs
a dead animal
a decomposer
to decompose
to rot
tiny pieces
soil

Materials:
1. Go to the forest and collect samples of decomposing wood and leaves. Try and get samples in various stages of decomposition, to show the process. If there is an area close to the school that shows decomposing material, take the students on a walk and show them these things.

2. At the completion of the lesson, make a display of the materials with labels on a table in the classroom. Make not of the stages of decomposition that are shown.

Identification Cards
(Labels for materials brought into the classroom)

TEACHING SUGGESTIONS:

1. Display the materials found in the forest (or take the walk to a similar area). Ask the students what they think is happening to the wood and leaves.

2. Write a word 'to decompose' on the board. Explain what it means for something to decompose.

3. Have the students look at page 236. Read and explain the text to the students. Explain that decomposers feed on wastes and discarded parts of living organisms as well as on dead bodies. Make sure everyone understand the actions or decomposers. The results are crumpled remains of dead matter.

4. Have the students discuss the answers to the questions on page 236. Also use these questions with the materials which you have collected.

5. Set up the display of materials. Ask the students to help you put the materials in the proper order to show decomposition.

DESIRED LEARNING OUTCOME: The student should be able to explain what decomposition is and what helps it to decompose.

****

DEVELOPMENT: Lesson Cluster 4B-3 After Organisms Die
Page T-430/S-237 Underground (50-60 min.)

PURPOSE: To develop the concept of decomposers and their actions and importance through observation of decomposition of different objects in soil. Lesson (3b) may be done instead of this lesson, or both may be done.

ADVANCE PREPARATION:

Background Information: In this lesson, the children are introduced to two types of decomposers. The tiny organisms referred to, though not named, are bacteria. Funguses are classified as plants, but are not green and, for the most part, cannot make their own food. (They get food from the objects they decompose.) Decomposition by both kinds of organisms should take place during this investigation. Bacteria will not be visible, though present, but funguses should be visible in the form of mold.

Materials:

1. Have enough clear plastic boxes for each pair of students. The soil should be moist, and should be collected from an area that has dark, rich soil. (Note: do not use potting soil bought from a store.) Have leaves, cooked beans, dead worms and meat ready for the lesson. Also have tongue depressors to use as labels.

Language Cards/Key Signs
a decomposer
a leaf
a bean
a worm
meat
size/color
shape/smell
a fungus
to decompose

2. Set up one box as a display, and label each part of the experiment.
3. Make a student worksheet with the following chart.

Identification Cards
a leaf
a bean
a worm
meat
a plastic box
soil

Object	CHANGES				
	Size	Color	Smell	Shape	Feel

4. Have a hand lens for each student.

TEACHING SUGGESTIONS:

1. Display all of the materials on a table. Have the students discuss the materials and name them.

2. Have the students look at page 237. Tell them that they will be finding out more about decomposers. Again, write the word on the board.

3. Read and explain the text to the students. Discuss the experiment. After you have explained the experiment, ask the students what they will do. List the steps on the board.

4. Ask the students to sit in pairs. Pass out the materials and have the students set up the experiment. When they have completed it, pass out the worksheet. Explain how they will record information on the paper. Save these papers until later.

5. During the three-week waiting period, have the students moisten the soil periodically to keep it damp but not soggy.

6. After 3 weeks have the students take out their papers. Ask them to look at the materials, using a hand lense, and record the information on their papers. Discuss their results. If mold is present on any of the materials, point it out. Explain that mold is a type of fungus and that it decomposes dead objects.

7. Have the students answer the numbered questions. Explain that the changes they recorded on their charts are all evidence of interaction with decomposers.

8. If the students show further interest in the decomposers, they could bury the materials for a longer time and observe them again.

DESIRED LEARNING OUTCOME: The students should be able to describe how decomposers affect dead objects.

****

DEVELOPMENT: Lesson Cluster 4B-3 After Organisms Die
Page T-432/S-238 Kinds of Decomposers (35-45 min.)

PURPOSE: To develop the concept of decomposers and their actions and importance through observation of decomposition of different objects in soil. Lesson (3b) may be done instead of this lesson or both may be done.

ADVANCE PREPARATION:

Background Information: This lesson introduces two kinds of decomposers - bacteria (not named as such) and funguses. Bacteria are referred to as tiny organisms in air, soil, and water. Funguses are non-green plants that cannot make their own food and receive nourishment from the material they decompose. Mushrooms, mold, cup fungus, and bracket fungus are examples of funguses that are decomposers.

An excellent film for children on the life and death of a mouse is discussed on page T-430, and instructions for ordering it are given.

Materials:
1. Collect samples of decomposing substances, especially wood with fungus on it. Or, if a forest area is nearby, take your class on a trip to observe the decomposing organisms. Bring back samples of the materials observed.

Language Cards/Key Signs
a decomposer
a tiny organism
a raccoon
a fungus

Identification Cards
Labels for materials brought into the classroom

TEACHING SUGGESTIONS:

1. Either take a trip to visit a forest area, or bring in samples from a forest area showing decomposition. Display the samples in the classroom, and label them.

2. Have the students look at the materials and discuss what is happening to them and what is causing the change. Ask which things are interacting to have this type of a result.

3. Have the students look at page 238. Read the text to them. Discuss the photographs. Make sure that they understand the word fungus.

4. Have the students answer the numbered questions, etc. (no mod.).

5. Display the materials in the classroom. If the class has gone on a field trip, bring back samples of decomposition and label and display these in the classroom.

DESIRED LEARNING OUTCOME: The children should be able to describe how decomposers affect dead objects and explain the importance of decomposers in the environment.

****

INTRODUCTION: Lesson Cluster 4B-3 After Organisms Die
Page T-428/S-235 Scavengers (15-20 min.)

PURPOSE: To introduce the concept of scavenger.

ADVANCE PREPARATION:

Background Information: Some animals feed almost entirely on other animals that have died. These are scavengers. They usually do not chase or hunt food. They wait until another animal has been killed or has died of other causes. A few scavengers feed on decaying plant materials (snails, raccoons, and earthworms, for example).

Language Cards/Key Signs
a scavenger
a sea gull
a lion
a hyena

Identification Cards
(Labels for pictures used in lesson)

Materials:
1. Collect pictures of scavenger animals such as: crows, rats, lobsters, crabs, vultures, crayfish, opossums, etc. Mount these on cardboard and label them.
2. Prepare a bulletin board for the pictures of scavengers. Use the word Scavengers for the title. Add a definition of a scavenger to the bulletin board. (See Glossary.)

TEACHING SUGGESTIONS:

1. Have the students look at page 235. Write the word scavenger on the board. Read the text to the students. As you do this, explain the meaning of the word scavenger.

2. Have the students look at the two pictures. Have them name the animals and explain what they are doing.

3. Show the pictures of scavengers which you have collected. The students may not know that they are scavengers. Explain the environment of each animal and how and what they feed on.

4. Ask the students if they have ever seen scavengers feeding on anything. (Question 2.)

5. Display the pictures on the bulletin board. As you do this, ask the students to explain what a scavenger is and what they eat.

DESIRED LEARNING OUTCOME: The children should be able to explain the term scavenger and name animals that are scavengers.

****

APPLICATION: Lesson Cluster 4B-3 After Organisms Die
Page T-434/S-239 Helpful and Harmful (25-35 min.)

PURPOSE: To apply the concepts of scavenger and decomposers to their effects on people.

ADVANCE PREPARATION:

Materials:
1. See teachers manual.
2. Make a display of the materials which you bring to class. Label the object and the decomposer.

Language Cards/Key Signs
a scavenger
a decomposer
an opossum
a snail
a mushroom
mold
fungus
wheat

TEACHING SUGGESTIONS:

Identification Cards
(Labels for materials
brought to class)

1. Remind the students that they have been discussing both scavengers and decomposers. Have them explain the meanings of these terms. Ask them what is a fungus. Tell them that a fungus can be involved in a good interaction.

2. Place the food samples on the table. Explain what each is, name it, and tell how a fungus is involved. Have the students taste the various things.

3. Have the students look at page 239-240. Name the objects/organisms in each picture and discuss the interactions. Write the terms A Helpful Interaction and A Harmful Interaction on the board. Have the students decide where each object/organism should be placed.

4. Display other examples of funguses on the table. Label and discuss each one.

5. Have the students answer the questions on page 240. Encourage them to explain why scavengers and decomposers are generally important to people.

DESIRED LEARNING OUTCOME: The children should be able to identify scavengers and decomposers that are helpful or harmful to people and describe their effects.

****

EVALUATION: Lesson Cluster 4B-3 After Organisms Die
Page T-436/S-241 Dead Organisms Change (20-25 min.)

PURPOSE: To evaluate the children's performance in relation to the following objectives:
1. Distinguish between a scavenger and an animal eater (predator).
2. Identifying eating interactions of decomposers.

ADVANCE PREPARATION:

Materials:
1. Prepare a student answersheet for the two questions.

Language Cards/Key signs
a decomposer
a scavenger
being decomposed

TEACHING SUGGESTIONS:

1. First review the terms used in this cluster. Include a discussion of the difference between a decomposer and something that is being decomposed.

2. Have the students look at page 241. Discuss thepictures.

3. Pass out the answersheet. Ask the questions and have the students write their answers on the paper.

4. When the students have finished their papers, discuss the answers. Informally discuss how scavengers and decomposers are helpful or harmful.

5. If a child answers correctly the questions you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 3 Unit 4 Population Interaction

Part C Many Populations Interact, Lesson Cluster 4C-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-442	Introduction	Energy in Food	35-40 min.
T-444	Introduction	Energy Chains in Eating	35-40 min.
T-446	Development	Food Chains End	25-30 min.
T-447	Development	Food-Chain Interactions	40-45 min.
T-448	Application	People in Food Chains	40-45 min.
T-449	Evaluation	Classroom Food Chain	20-25 min.

B. MATERIALS: See list on page T-439.

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interactions in a Population, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4C-1 Food Chains
Page T-442/S-243 Energy in Food (35-40 min.)

PURPOSE: To identify the sun as an energy giver and plants as energy receivers. Also to state that animals get energy from other organisms.

PREREQUISITES: Exposure to the concept that plants make food using energy from the sun.

ADVANCE PREPARATION:

Background Information - All life depends on energy for its continued existence. This energy comes in the form of chemical energy stored in food. Organisms use the energy for all internal and external (obvious) activities, such as digestion, growth, speech, and movement.

Although energy was covered in Unit 3, the concept of chemical energy is too abstract for children at this level. In this cluster, the children should be encouraged to think of energy for living as a form of energy called "food energy." This energy from food enables organisms to do everything they do, voluntary or involuntary, and thus stay alive.

The sun is the original source of food energy (in the form of light energy). All animals and nongreen plants rely on green plants directly or indirectly for their food. This is because green plants are the only organisms that can convert light energy from the sun and certain chemicals into food. They do this through a process known as photosynthesis. Chemical energy is stored in the food produced during photosynthesis. Plants use the food they make to obtain energy for vital functions. Plant eaters get energy from the food stored in the green plants they eat. Animal eaters get energy from plant eaters they eat of from other animal eaters. An animal eater's food energy can be traced back through several eating interactions to green plants, and ultimately to the sun.

This lesson applies to photosynthesis the concept of energy giver and energy receiver that was developed in Unit 3, Interaction and Energy. It introduces the idea that the sun is an energy giver and a green plant an energy receiver when sunlight strikes it. The interaction is photosynthesis (food production). Energy is transferred from the sun to the food produced and stored within the plant.

Materials -

1. Go back to T-313 Enrichment Lesson, 'Don't Break the Chain' and reread the rules of this game.
2. Make cut out pictures of a sun, a tree, other plants, arrows and labels for these things. Make a title: An Energy Chain. At the end of the lesson these things can be put up on a bulletin board.
3. Take out one set of cutouts from the energy chains of section B-3 (unit 3), to be used as a review.

Language Cards/Key Signs

an energy chain
an energy giver
an energy receiver
the sun
a plant
an organism
interaction

Identification Cards

an energy chain
the sun
energy
a plant
an energy giver
an energy receiver

TEACHING SUGGESTIONS:

1. Write the words An Energy Chain on the board. Ask the students if they remember what that was. Show them cutout pictures and arrows from the lesson in unit 3. Ask one student to put them in order and explain what an energy chain is.

2. Tell the students that they are going to play the energy game again. Write the words: interaction, an energy giver and an energy receiver on the board. Have different students explain the terms. Review the rules of the game. Play the game for five to ten minutes.

3. Have the students look at page 243. Explain to them that they will be talking about another kind of energy chain. Take out the cutout pictures. First place the sun on the blackboard. Ask the students to name it. Then place the tree on the blackboard. Ask the students if these two things could make up an energy chain. Add the arrows to show the direction of the energy. Also ask a student to label the energy giver/receiver.

4. Read the text to the students. Reminding them that plants make food using energy. Show the other cutouts of other plants. Make an energy chain from these things.

5. Explain that animals get energy in two ways. They can eat plants or they can eat animals that eat plants. Ask the students to give examples of these two types of animals.

6. Ask the students question #3 on page 243. Discuss their answers.

7. Have the students help you set up the bulletin board at the completion of the lesson.

DESIRED LEARNING OUTCOME: The students should be able to explain that the sun and plants make up an energy chain and that animals get energy from plants or animals that eat plants.

****

INTRODUCTION: Lesson Cluster 4C-1 Food Chains
Page T-444/S-244 Energy Chains in Eating (35-40 min.)

PURPOSE: To introduce the concept of energy transfer during eating interactions and the concept of food chain as a type of energy chain made up of eating interactions.

ADVANCE PREPARATION:

Background Information - This cluster applies to eating interactions the concept of energy chain that was developed in Unit 3. A food chain is an energy chain made up of a series of linked eating interactions. It always begins with the sun (the original source of energy for all life), followed by a green plant. In each eating interaction, energy is passed from one organism (the food) to another (the eater). This energy transfer is represented by an arrow going from the energy giver to the energy receiver. In a food chain, the energy receiver in one eating interaction becomes the energy giver in another (when it is eaten). A food-chain diagram shows (with arrows) the movement of the sun's energy from one organism to another. The diagram also shows what organism is food for what other organism. Keep in mind that the arrows indicate energy transfer between organisms. Make sure you do not reverse the arrows, they should always point away from the sun from left to right. A food chain may also be thought of as showing interactions between several populations, with each illustrated organism representing a population.

Materials -

1. Make cutout pictures of: sun, grass, cricket, toad, arrows, and the labels to go with them.
2. NOTE: The textbook need not be used for this lesson because there is too much reading materials. It can be more clearly explained using class discussion and the cutouts put on the board.

TEACHING SUGGESTIONS:

1. Explain to the students that they will be learning about energy chains in eating. First show the students the various cutouts (in no particular order) and have them name them.

2. Ask the students if they could make an energy cahin with these things. Allow a student to try this by taping the cutouts on the board. Have the other students decide if it is correct.

Language Cards/Key Signs
a food chain
an energy giver
an energy receiver
grass
a cricket
a toad

Identification Cards
a food chain
an energy giver
an energy receiver
the sun
grass
a cricket
a toad
energy

3. When you have the correct chain, tell the students that this is an energy chain, but it also can be called a food chain. Write the words Food Chain above the cutouts.

4. Talk through the chain, discussing each interaction. When you have completed your explanation, ask several students to do the same thing, explaining the interactions in the chain. During the discussion, be sure to emphasize the use of the terms energy giver and energy receiver.

5. Emphasize that a food chain always begins with the sun, followed by a green plant. This is because the sun is the original source of energy for all life, and plants are the only organisms that can change the sun's energy to food energy. Animals get energy by eating other organisms. Tell the students that the food chain diagram helps you to trace the movement of energy from one organism to another, and shows what organism eats what other organism.

6. Ask the students the questions from page 245. Discuss their answers.

7. Display the food chain on a bulletin board or wall in the classroom.

DESIRED LEARNING OUTCOME: The children should be able to explain what a food chain is and describe how to construct one.

****

DEVELOPMENT: Lesson Cluster 4C-1 Food Chains
Page T-446/S-246 Food Chains End (25-30 min.)

PURPOSE: To develop the concept that food chains end with decomposers.

ADVANCE PREPARATION:

Background Information - Decomposers, such as bacteria and funguses, end every food chain when an animal or plant dies (and is decomposed). This can occur at any level of a food chain. As a result, food chains vary in length (number of elements). Decomposers are represented in Part C by a labeled box, because they are too varied and too small to be illustrated.

Decomposers return to the soil important materials that are re-used by living green plants in other food chains. However, energy cannot be re-used. Green plants must get their energy directly from the sun.

Materials - 1. Use the cutouts from the previous lesson, adding a snake, and a sign saying decomposers.

Language Cards/Key Signs
a food chain
a decomposer
a snake
a dead organism

Identification Cards
the sun
grass
a cricket
a toad
a snake
decomposers

TEACHING SUGGESTIONS:

1. Have the students look at page 246. Explain that a food chain will end. Read the text to the students, asking what will happen to the toad's body.

2. Ask the students what is a decomposer. Using the cut-out pictures have a student construct the food chain up to the toad. Then introduce the snake. Ask what would happen to the toad. Then ask what could happen to the snake. (It could die, leaving its body for the decomposers.)

3. Explain that a food chain may end at any point if an organism (even a plant) dies and is decomposed before being eaten. Use the cutouts to help explain this. Point out that materials from the dead organisms are returned to the soil and re-used by living green plants, but the energy is not re-used.

4. Have the students answer the numbered questions.

5. Again, use this food chain as a display in the classroom.

DESIRED LEARNING OUTCOME: The children should be able to explain that a food chain always ends with decomposers.

****

DEVELOPMENT: Lesson Cluster 4C-1 Food Chains
Page T-447/S-247 Food-Chain Interactions (40-45 min.)

PURPOSE: To further develop the concept of food chain and to provide practice in constructing a food chain.

Language Cards/Key Signs
a food chain
an interaction
a tiny green plant
a water flea
a minnow
a bass
a decomposer

Identification Cards
the sun
a tiny green plant
a water flea
a minnow
a bass
a mouse
an owl
a corn plant
decomposers

ADVANCE PREPARATION: Materials -

1. Make cutout pictures of: the sun, algae, daphina, minnow, bass, mouse, owl, cornplant, and decomposers label. Also make labels for all of these things.
2. Prepare a worksheet for the students which has pictures of the sun, mouse, owl, cornplant, and decomposers label which they can cut out and glue to the paper in the proper order. (The students should draw the arrows.)
3. On another worksheet, have a chart headed with: Energy Giver, Energy Receiver, for the students to fill in after completing the chain.
4. Have glue and scissors for each student.

TEACHING SUGGESTIONS:

1. Have the students look at page 247. Explain that they are going to learn about two other food chains. Place the cutouts on the board one by one, asking the students to identify the organism, and which is the energy giver/energy receiver.

2. Make a chart on the board titled: Energy Giver and Energy Receiver. Ask the students to tell you what the pairs are from this food chain.

3. Pass out the worksheets. Place the cutouts of the new food chain on the board in no particular order. Ask the students to name each thing. Then explain that they will be making their own food chain. Tell them that they must cut out the pictures and place them in the correct order. Also tell them that they must add the arrows in the pictures and label each thing. Explain the second worksheet and how they are to fill in the chart.

4. Help the students if necessary with their work. When they have completed their papers, have one student, using the cutouts, show the food chain on the board. Have the other students comment on it. Discuss the chart, writing it on the board if necessary.

DESIRED LEARNING OUTCOME: The children should be able to construct a food chain that shows how certain organisms interact and identify the pairs of energy givers and energy receivers in the food chain.

****

APPLICATION: Lesson Cluster 4C-1 Food Chains
Page T-448/S-248 People in Food Chains (40-45 min.)

PURPOSE: To extend the concept of food chain to include people.

ADVANCE PREPARATION:

Background Information - In the food chains on page 248, decomposers were omitted to avoid the possibility of upsetting the children. As a result, the food chains are incomplete. To be precise, decomposers should be shown ending the food chains. You may wish to mention this in class.

Materials -

1. Prepare a student worksheet where they can draw the different food chains. Have room for six different chains.

Language Cards/Key Signs
a food chain
a person
an apple tree
an orange tree
lettuce
a hamburger

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by pointing out that an organism (in this case a person) can be part of more than one food chain.
2. Have the students look at page 248. Discuss the two food chains. Explain that they show that people eat more than one kind of food. Remind the students that animals often eat plant parts or products rather than the whole plant. If a child points out the lack of decomposers, indicate that he or she is incorrect.
3. Have the students look at the picture of the lunch tray. Have the students name each object. Write the names on the board. Then ask the students if they could tell you where these things came from. Write that after the name. Give help or explanation where necessary.
4. Pass out the worksheets. Explain what the students are to do. Have them make up the food chains. When they have finished, display their papers and discuss their answers.
5. You may wish to have the students construct other food chains for food that they had for breakfast or dinner the day before.
6. Have the students discuss the numbered questions.

DESIRED LEARNING OUTCOME: The children should be able to tell how people are parts of food chains and construct food chains that include people.

****

EVALUATION: Lesson Cluster 4C-1 Food Chains
Page T-449/S-249 Classroom Food Chains (20-25 min.)

PURPOSE:
1. To construct a food chain that shows how a given set of organisms interact.
2. Identify the sun as the beginning of the food chain and the decomposers as the end.

ADVANCE PREPARATION: Materials -

1. NOTE: The textbook page 249 need not be used for this evaluation.
2. Prepare a student worksheet including: pictures of a toad, cricket, grass, sun, decomposers sign, all that can be cut out and glued onto another part of the worksheet, to fill-in questions 1. The first thing in the food chain is ________. The last thing in the food chain is ________.
3. Have scissors and glue for each student.

TEACHING SUGGESTIONS:

1. Pass out the worksheet. Explain that they are to cut out the pictures, place them on the paper in a food chain and add the arrows. Also tell them that they should label the pictures, and that you will help with spelling.

2. When the students have completed the worksheet, discuss their answers.

3. If a student correctly answers the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 3 Unit 4 Population Interaction

Part C Many Populations Interact, Lesson Cluster 4C-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-454	Introduction	Several Food Chains	35-40 min.
T-456	Development	Farm Food Web	35-40 min.
T-457	Development	Make a Food Web	35-40 min.
T-461	Evaluation	Stream Food Web	30-35 min.

NOTE: The application lesson has been deleted.

B. MATERIALS: See list on page T-451.

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction in a Population, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4C-2 Food Webs
Page T-454/S-250 Several Food Chains (35-40 min.)

Purpose: To introduce the concept that a population is usually part of several food chains and the concept of food web as a combination of several food chains that have some of the same populations.

ADVANCE PREPARATION:

Background Information: A food chain usually shows one kind of plant being eaten by one kind of animal that is eaten in turn by another kind of animal, and so on. This represents one possible sequence of eating interactions isolated from a myriad of overlapping eating interactions among many populations in one area. Usually, different kinds of animals feed on the same plant of animal population. Also, one animal population usually feeds on a variety of plants or animals. This means that members of a population can be part of more than one food chain, and that different food chains may contain members of the same populations. These food chains may be combined (overlapped) to form what is known as a food web.

A food web begins with the sun and consists of organisms connected by arrows. Each organism represents an entire population rather than an individual. A food-web diagram shows the ways various populations in a particular area interact with each other (by eating).

To make a food web complete, decomposers should be included with an arrow going to them from every population. This is because some members in every population die before being eaten and are decomposed. Decomposers were omitted from the food webs here to avoid the complexity that the additional arrows would produce. You may wish to add decomposers and their arrows to food webs on the chalkboard. Note that decomposers do not "end" food webs, because populations as a whole renew themselves; whoe populations usually are not decomposed at once.

Food webs represent repeating interactions and usually do not end.

Materials:
1. NOTE: Do not use page 250, the pictures are confusing.
2. Make cutouts of the things pictured on page 251. Make several cutouts of each picture. Also make enough arrows to make the food chains and web.
3. Make letters for a bulletin board: A Food Web, and a definition for a food web.

Language Cards/Key Signs
a food chain
a food web
a lettuce plant
a mouse
a rabbit
a wheat plant
a population

Identification Cards
a lettuce plant
a wheat plant
the sun
mice
rabbits
owls
cats

TEACHING SUGGESTIONS:

1. Begin the lesson with the cutouts. Place the sun on the board. Add a lettuce plant. Ask the students which is the energy giver/energy receiver. Have one student add the arrow. Show the other pictures, ask what should be nect in the chain. You should get different answers (mice, rabbits). Then tell the students that they can make two chains. Make the chains on the board.

2. Let the students look at the chains. Tell them that there is a way that you can put the chains together. Tell them that it would make a food web. Write these words on the board.

3. Encourage the students to develop a way to form a food web. Do not tell them the answer unless they are having a great deal of difficulty.

4. Once they have begun to get the idea of a food web, have them look at page 251. Explain that this is a food web using all of the organisms.

5. Make the food web on the board, by having the students place the cutouts and arrows in the appropriate places. Discuss each part of the web.

6. Read the text from page 251 to the class. Have the students answer the numbered questions.

7. From the food web, have the students identify the food chains by tracing them on the board.

8. Place the food web on a bulletin board in the classroom.

DESIRED LEARNING OUTCOME: The children should be able to describe how a population is part of several food chains and explain what a food web is and how it is formed.

****

DEVELOPMENT: Lesson Cluster 4C-2 Food Webs
Page T-456/S-252 Farm Food Web (35-40 min.)

PURPOSE: To develop the concept of food web and to provide practice in identifying food chains in a food web.

ADVANCE PREPARATION:

Materials:

1. Make cutouts of all of the things in the food web on page 252. Also make labels for the pictures.

2. Make a student workwheet with spaces for them to list the eight food chains in this food web.

Language Cards/Key Signs
a food web
a population

Identification Cards
corn plants
the sun
cabbage plants
grass
chickens
people
caterpillars
birds
cows

TEACHING SUGGESTIONS:

1. Tell the class that they will be looking at a Farm Food Web. Begin placing the cutouts on the board, one by one. Discuss each interaction before placing the next cutout on the board. Be sure that the students understand the interaction before going on to the next.

2. Ask several students to place the labels under the pictures in the food web.

3. Pass out the worksheets. Tell the students that this food web is made up of eight food chains. Ask them to be detectives and find all eight. They should write the names of the organisms on their papers in the spaces provided. Remind them to add the arrows.

4. When the students have completed their papers, discuss their answers. Have each student give one food chain. They could be listed on the board.

5. Ask the students to look at the food chains and tell you which things interact the most, i.e., which are listed most often in the chains. Ask which plant populations and which animal populations are listed the most often.

DESIRED LEARNING OUTCOME: The children should be able to identify food chains that make up a food web and state which populations interact the most in the food web.

****

DEVELOPMENT: Lesson Cluster 4C-2 Food Webs
Page T-457/S-253 Make a Food Web (35-40 min.)

PURPOSE: To develop the concept of food web and to provide practice in constructing a food web from several given food chains.

ADVANCE PREPARATION:

Materials:

1. Take 3x5 index cards and cut them in half. Make a set of pictures (from page 253) for each student.
2. Have large sheets of paper, magic markers, and glue ready for each student.

Language Cards/Key Signs
chrysanthemums
aphids
ladybugs
praying mantises
grasshoppers
a food web

TEACHING SUGGESTIONS:

1. Have the students look at page 253. Read the text to them. Discuss each one of the food chains.

2. Pass out the cards. Ask the students to label each picture. Tell them that they will be taking the pictures and making a food web from them.

3. Pass out the large sheets of paper, markers and glue. Ask the students to write a title on their paper - A Food Web. Ask them to take the pictures, and using their book as a guide, make the food web. Tell them not to glue the pictures onto the paper until you have checked their work.

4. Make sure that you check each student. If they have mistakes, refer them to the textbook to find their error. When their web is correct, allow them to glue the cards onto the paper.

5. Have the students answer the questions from page 253. Discuss their answers. For question 2, remind them to count the arrows that go to and from each population.

6. Discuss question 3 with the students. It should be clear that the animal eaters would lose all of their food. Ask how this would affect the size of the remaining populations (plants would increase, animals would die off).

DESIRED LEARNING OUTCOME: The children should be able to construct a food web from several given food chains and describe the possible effect when certain populations are removed from the food web.

****

EVALUATION: Lesson Cluster 4C-2 Food Webs
Page T-461/S-255 Stream Food Web (30-35 min.)

PURPOSE:
1. Telling how many food chains make up a food web.
2. Listing the populations in the food chains.
3. Telling which populations interact the most in the web.

ADVANCE PREPARATION:

Materials:

1. Prepare a student answer sheet with the following: at the top of the page, draw the food web from page 255, label each picture, have spaces for 8 food chains to be written in (there are only five), leave additional space for answers at the bottom of the page.

TEACHING SUGGESTIONS:

1. Pass out the student answer sheet. Discuss the food web, identifying the populations and interactions.

2. Tell the students that they must find out how many food chains are in the web. Ask them to place the names of the populations in the spaces provided and to add the arrows.

3. When the students have completed that part of the evaluation, ask one more question. Which populations are in more than one food chain? Have the students

list them on their papers.

4. After the students have completed their work, discuss their answers.

5. As an informal discussion question, ask the students what makes food chains join together into a food web?

6. If the students have correctly filled in their answer sheets, then you can assume that they have demonstrated the objective for the cluster and are ready to go on to the next cluster.

****

DELETE the whole next cluster. The materials need too much pre-teaching and are abstract for this level of student.

SFHI

LEVEL 3

SIGNED VOCABULARY AND LANGUAGE INDEX FOR SCIENCE FOR THE HEARING IMPAIRED

Instructions for use of this index with the accompanying signed videotapes are found in the Introduction to the Program. This index should be used as a script when viewing the signed videotapes for the specific SFHI cluster or section of interest.

Each part of the videotape is preceded by an indication of the specific location (level, unit, part, Cluster and Lesson) of the item presented. Each item within a lesson is first presented in American Sign Language (ASL) followed by a Manually Coded English (MCE/SEE) presentation of the same item. When a lesson list is completed the title of the next lesson is given, followed by a presentation of each new lesson item in ASL and MCE.

Teachers should view the videotape in planning for each new cluster (2-5 minutes per cluster). It is also suggested that teachers view and practice the signs presented with their classes following lesson experiences or as a review. The videotape can be used as a visual dictionary when the children have forgotten the sign.

The Signed Vocabulary and Language Videotapes are available for purchase and/or copying by writing

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Science For The Hearing Impaired
Signed Vocabulary Level 3

Lesson — **Title and Key Signs**

Cluster 1A-1 **Sampling and Estimates**

1 **The World of Objects**
samples/sampling
estimating
objects
contents
variation
any lump of matter
alike
different
property

2 **Samples**
samples
insects
property
moths
common property

3 **Estimating/How Many Marbles?**
estimate

4 **Estimating Size**
size
giraffe

5 **Samples and Estimates**
bank
pennies

Cluster 1A-2 **Grouping Objects**

1 **Sorting Collections**
property sort

2 **Grouping by Properties**
group/groups
property
a button/buttons

3 **The Two Big Groups**
living
non-living
scientist
flash light
lock
airplant
lizard

Lesson — **Title and Key Signs**

3(cont)
butterfly
snake
rabbit
cactus
alarm clock

4 **Alike in Several Ways**
to belong
an insect
feelers (antennae)

5 **Sample Group**
reel oak
white oak
shingle oak
sample

6 **Find The Groups**
to notice
rough
hard
striped

Cluster 1A-3 **Variation in Groups**

1 **What is Variation?**
exactly alike
variation
size
color
shape
pattern

2 **Variation Collections**

3 **Finding Variation**
surface
bolts
shells
rocks
smooth
bumpy

4 **Variation Everywhere**
everywhere
somewhat alike
hairy

5 **Find The Variation**

Lesson	Title and Key Signs
Cluster 1A-4	Describing Variation
1	Order and Range order light green dark green lightest darkest range pea pods smallest largest
2	Histogram Practices histogram number of seeds
3	Making a Histogram kind a shaded block lima bean sunflower seed corn pea squash kidney beans a block the smallest the most
4	Measuring Variation to measure the eye of a potatoe a piece of string distance a centimeter ruler a washer variation a centimeter
5	Variation in Your Class height to describe
6	Find the Variation length
Cluster 1B-1	The Matter of Objects
1	Collecting Samples of Matter metal wood
1(cont)	glass plastic What is the object made of?
2	What Are Objects Made Of? matter
3	Properties of Matter to compare an example light heavy hard soft bend break wire to number over and over
4	Variation in Wood pine redwood sand paper to rub hardness
5	Raw Materials raw materials coal iron ore the earth steel lumber paper
6	Choose The Matter
Cluster 1B-2	Phases of Matter
1	Changing Matter solid liquid gas to change What is happening? phase phases of matter ice water vapor

Lesson Title and Key Signs

Cluster 1B-2 (cont)

2 Heat Changes The Phase
to melt
butter
taken away
a freezer
to condense
drops of water

3 Thermometers
Thermometer
a celsius thermometer
degree
temperature

4 Temperature and Change
a thermometer
degrees Celsius
compare

5 A Burning Candle
a candle
to burn
wax
an arrow

6 Find The Phase

Cluster 1C-1 Variation in Systems

1 Interaction Systems
a dry cell (battery)
wire
a bulb
tape
interaction
a system
to touch

2 Repeating Systems
to repeat
repeating systems
over and over again
variation

3 Similar Systems
iodine
sugar
flour
milk
vinegar

Lesson Title and Key Signs

3(cont) lemon juice
alike
different

4 A Bean Bag Contest
a bean bag
the limit mark
the goal mark
the player
the histogram (review)
a centimeter ruler
to take turns
range

5 People and Systems
musical instruments
a drum
a piano (or other available instruments)
sound

6 Find The Systems
a driver
a bumper car
a ferris wheel
people
a washer
a guitar
to strum
a pencil
string
a table
a hand
tape

Cluster 1C-2 Prediction

1 Galileo's Prediction
prediction
a scientist
an idea
speed

2 What is a Prediction?
a guess

3 How Sure Are You?
to be sure
pretty sure
explain

Lesson Title and Key Signs

Cluster 1C-2 (cont)

4 Using Predictions
a stop light
to brush your teeth
a stove

5 Making Predictions
sand
a sand castle
a tennis raquet
clouds
a storm

Cluster 2A-1 Space Everywhere

1 Exploring Space
space
the sun
the moon
the stars
to explore
air
a problem
a powerful machine
a rocket
the surface
gravity

2 Out in Space
a telescope
billions of stars
a galaxy

3 Our Solar System
a planet
the solar system
an orbit
farthest
closest

4 Marbles and Space
a marble
a tray

5 A Space For Everything
a rock

Lesson Title and Key Signs

6 A Place in Space
a football player
a doorway
a basketball hoop
a basketball player

7 Find The Space
a goldfish bowl
the Earth

Cluster 2A-2 The Space Inside

1 Closing in Space
space
hollow

2 Comparing Space
volume

3 Measuring Volume
a cubic centimeter
a shape

4 Find The Volume

5 Finding the Space Inside
largest

Cluster 2B-1 A Place In Space

1 Lost and Found
lost
found
a fisherman
a two-way radio
position
reference object

2 Direction
in front of
behind
above
under
right
left

3 Distance
far
near
very far
very near

Lesson	Title and Key Signs
Cluster 2B-1 (cont)	
4	Describing Positions an artist
5	Find It a sailboat a cloud a rowboat land
Cluster 2B-2	Position Finders
1	Place and Position place position a circle a square a triangle a star across a position finder
2	Position Picture a clown
3	A Position Game dice marker partner straight row the winner
4	Your Own Position Finder a clock face a fastener seam binding a position finder
5	Clock Direction Finder a clock an hour the center the direction
6	Clock Position Finder direction distance a centimeter
7	Find the Positions

Lesson	Title and Key Signs
Cluster 2C-1	Investigating Motion
1	What is Motion? motion changing position reference object a skier a slide
2	Steps in Motion Which picture is missing? a row of pictures a fence a sailboat a building
3	Making Flip Books a flip book to staple to flip smoothly
4	Look for Motion a school bus a swing a net
Cluster 2C-2	Clues of Motion
1	Motion Blurs a blur a clue a camera a photographer
2	What Moved?
3	You Can Be Fooled to be fooled a camera
4	Tracks a mark a clue of motion a bike tire a paw print direction

Lesson Title and Key Signs

Cluster 2C-2 (cont)

5 Interaction Clues
interaction
clues of motion
a windshield
a hammer
a branch

6 Which Parts Moved?
a clock
a bicycle
a pedal
a reflector
a timer

7 Find the Clues
a runner
a motorcycle
bowling
pins
a bowling ball

Cluster 2C-3 Describing Motion

1 Study the Tracks
a cardboard box
flour

2 Paths of Motion
a circular path
a straight path
a swinging path
a spiral path
direction
arrow

3 Viewing Paths
different views
a yo-yo
a front view
a side view

4 Draw the Paths

5 Find the Motion

Lesson Title and Key Signs

Cluster 3A-1 Interaction and Systems

1 Interaction Objects
interaction
system
cream
butter
a cracker
lawn mower
a grass collector
a puddle
a curb

2 Pick a System
cloth
scissors
a needle
chalk
thread
a pencil sharpener
a rake
a trowel
soil
a system

3 Naming System
a camera
a sled
a brick
a window
a flash cube
a baseball
flashing
crashing
hitting
a bat

4 Picture This

5 Many Systems
throwing
shooting
swinging

Cluster 3A-2 Variables in Systems

1 Change in a System
a flashlight
a mirror
clay

Lesson	Title and Key Signs
Cluster 3A-2 (cont)	
1(cont)	a ball a variable to reflect
2	Working With Variables a wobble system a washer string fastest slowest
3	More Wobble Systems
4	Sports Variables
5	Name the Variables a pond lilly pad frog ice snow
Cluster 3A-3	Energy in Systems
1	Energy energy interaction crashing sliding hitting moving systems
2	Moving Systems the energy giver the energy receiver
3	Energy Givers You Cannot See sailboat
4	Moving Systems in Your Class Room a shade
5	Energy Givers and Receivers
Cluster 3B-1	Kinds of Energy
1	Many Kinds of Energy motion heat electricity
1(cont)	magnetic sound energy light
2	Magnetic Energy a magnet to attract a horseshoe to repel a rectangle round magnetic energy a bar magnet
3	More About Magnetic Energy
4	Motion-How Far? a variable a distance tester
5	Where is the Energy? iron filings
Cluster 3B-2	Making Energy Changes
1	Controlling Energy string a pencil tape a filmstrip case a centimeter a pendulum an energy giver an energy receiver
2	More and More Energy a washer a pendulum energy to control a variable
3	Target the Energy a target
4	Giving Energy a prize a hammer
5	Energy Control

Lesson Title and Key Signs

Cluster 3B-3 Energy Chains

1 The Millie McPherson System
a chute
a slide
to spill
to dump

2 Willy's System
an energy chain

3 Don't Break the Chain
a chain

4 Complete the Chain

Cluster 3C-1 Finding Energy Givers

1 The Popcorn System
baking soda
vinegar
spoon
popcorn
to rise
a gas
bubbles
a system

2 How Many Trips
a trip
vinegar
baking soda
a spoon
a kernal of popcorn
a variable

3 Variables in a System
a larger time
variables

4 Using Gas Movers
an air bag
a ship
the surface of the water

5 Find the Energy Givers
gas
a pinwheel
popcorn kernals
variables

Lesson Title and Key Signs

Cluster 3C-2 Mystery Movers

1 What Makes it Move
a paper pointer
a card
aluminum foil
straight
to bend
energy transfer
heat

2 Which Place
a different place
by a door
under a light
in the dark
near a window
in the sunshine
heat

3 Which Way
aluminum foil
a pointer
heat
place
position

4 Find the Pointer

Cluster 3C-3 Light Energy

1 Light is Energy
a flashlight
a lamp
a candle
light energy

2 Light and Color
a prism
an energy giver
an energy receiver
to absorb
to reflect

3 Mirrors
a mirror
an image

4 Find the Changes
symmetrical

Lesson Title and Key Signs

Cluster 3C-3 (cont)

5 Light Stoppers
to pass through

6 Using Light Energy
solar energy

7 All About Light

Cluster 4A-1 Interactions

1 Interacting Organisms
organism
a plant
an animal
interaction

2 Helpful Interactions
a population
helpful ways
to play
to clean

3 Some Animals Fight
to fight
to harm
a seagull
a stickleback
fighting

4 Animals on the Move
spring
winter
fall
summer
to migrate
a group
a population
a place
Canada
a reindeer
a whale
North America
California
Alaska
a forest
a coast
an ocean

5. People on the Move
an Eskimo

Lesson Title and Key Signs

5(cont) a seal
a walrus
the Pacific Ocean
the Artic Ocean
Hudson Bay

6 Many Interactions
cleaning
fighting
playing
interacting

Cluster 4A-2 Home-Building Interactions

1 A Mouse Home
a mouse
mice
cardboard
cotton
a house
a box
a stick
cedar chips
an exercise wheel

2 Animals That Build Homes
an object
building a home
a beaver
a gannet
a home

3 People Build Homes
a farm house
an apartment
an adobe pueblo

4 Building Homes

Cluster 4A-3 Young and Old Interact

1 A Mouse Family
a litter
a baby
to nurse
milk
to mate
male
female

Lesson Title and Key Signs

Cluster 4A-3 (cont)

2 Caring for Young
to care for
to feed
to protect
a monkey
a racoon
to carry
young

3 On Their Own
a tortoise
a tadpole
a frog

4 Children's Needs
a child
children

5 Different Young Animals

Cluster 4B-1 Plant Eating Interactions

1 Some Animals Eat Plants
to eat
interaction
a population
a beetle
sheep
herbivore
an organism

2 Start an Aphid Population
an aphid
an experiement
an egg
a young aphid
a wingless adult
a winged adult

3 Favorite Foods
a grasshopper
a cricket
a caterpillar
a beetle
a terrarium
a population
a planteater (haebivore)
favorite
a net
ajar

Lesson Title and Key Signs

3(cont) corn plant
bean plant
grass
a radish plant
seeds

4 Park Interactions
a bird
a squirrel

Cluster 4-B2 Animal Eating Interactions

1 Aphids and Ladybugs
an aphid
a ladybug
a population
to interact
to compare
number
a chart
ID card-cheesecloth

2 Some Animals Eat Animals
a starfish
a mussel
an owl
a mouse
an animal eater

3 Plant-and-Animal Eaters
a plant and animal eater
an omnivore

4 Odd Animal Eaters
a toad
a chameleon
a cricket

Lesson Title and Key Signs

4(cont) an animal eater
an experiment

5 Find the Animal Eaters

Lesson	Title and Key Signs
Cluster 4B-3	**After Organisms Die**
1	**What are Decomposers?** a dead animal a decomposer to decompose to rot tiny piece soil
2	**Underground** a leaf a bean a worm meat size/color shape/small a fungus a plastic box
3	**Kinds of Decomposers** a tiny organism a racoon a fungus
4	**Scavengers** a scavenger a sea gull a lion a hyena
5	**Helpful and Harmful** an opossum a snail a mushroom mold wheat
6	**Dead Organisms Change** being decomposed
Cluster 4C-1	**Food Chains**
1	**Energy in Food** an energy chain an energy gives an energy receives the sun a plant an organism interaction energy
2	**Energy Chains in Eating** a food chain grass a cricket a toad
3	**Food Chains End** a food chain a decomposer a snake a dead organism decomposers
4	**Food-Chain Interactions** an interaction a tiny green plant a water flea a minnow a bass a water flea a mouse an owl a corn plant
5	**People in Food Chains** a person an apple tree an orange tree lettuce a hamburger
6	**Classroom Food Chains**
Cluster 4C-2	**Food Webs**
1	**Several Food Chains** a food chain a food web a lettuce plant a mouse a rabbit a wheat plant a population mice owls cats the sun
2	**Farm Food Web** food web population corn plants

Lesson	Title and Key Signs
Cluster 4C-2 (cont)	
2(cont)	cabbage plants grass chickens people caterpillars birds cows
3	Make a Food Web chrysanthemums aphids lady bugs praying mantises grasshoppers a food web
4	Stream Food Web

Teachers Guide for Level 4

SCIENCE

Adapted

For the Hearing Impaired

Dennis W. Sunal
Cynthia Szymanski Sunal

SFHI

SCIENCE

for

the HEARING IMPAIRED

Level 4

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Appendix

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Introduction

Many teachers and administrators have long been concerned with the lack of appropriate science materials and aids for teaching hearing impaired youth. This disadvantage is most critical for the middle childhood aged student in special hearing impaired classrooms or joined with their hearing peers in regular classrooms. Many students have been denied adequate access to science as a discipline because it was too difficult or because ways to present it to hearing impaired youth beyond traditional methods could not be envisioned.

To meet this concern the Science for the Hearing Impaired (SFHI) project was proposed. Its primary aim was to make available, for the first time, a complete sequenced science program for the hearing impaired which would foster the development of abilities and attitudes in the sciences in hearing impaired youths at this critical age.

This volume represents two years of planning, development, classroom testing, evaluating, and rewriting to produce a science program effective for hearing impaired middle childhood youths. To date, the success of these materials with teachers and students has been assuring. The SFHI introductory guide which describes the program materials, teaching strategies and use of program components, along with the individual program teacher's guides presents all essential information needed for maximizing learning for this special population of youth.

Level 4 Unit 1 Environments

Part A Interactions In An Environment, Lesson Cluster 1A-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-41/43	Development	Start A Fruit Fly Population and Germinate Bean Seeds	40 min.
T-38	Introduction	Start a Bean Population	40 min.
T-39	Development	Start Other Bean Plants	25-35 min.
T-44	Application	Bean Plant Growth	40 min.
T-42	Enrichment	A Cricket Environment	30-40 min.

B. MATERIALS: See list on pages T33, 34, 35.

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction In a Population, is appropriate for use in this unit.

DEVELOPMENT: Lesson Cluster 1A-2 Preparing for Later
Page T-41/S-12 Start a Fruit Fly Population and Germinate Bean Seeds (40 min.)

PURPOSE: To introduce the concept of environmental factors best suited to the growth of a population of fruit flies.

PREREQUISITES: Fine motor skills.

ADVANCE PREPARATION: Materials - very ripe banana
- large jar or bottle
- rubber bands
- gauze
- dry grass
- sugar

1. Use the appropriate determiners for the identification cards. Matching cards to objects could be done to test recording learning.
2. Develop simple graphs for recording days and numbers of fruit flies.

TEACHING SUGGESTIONS:

1. Distribute the student books. Allow time for the students to browse through them and discuss points of interest with their classmates. Take notes of which students focus on which areas of the book.

Language Cards/Key Signs
egg
pupa
larva
adult
stages
population
glossary

Identification Cards
fruit fly
banana
guaze
container
dry yeast
masking tape
food mix

rubber bands

2. Point out that the book is divided into 4 units. List the units on the board and have the children discuss what they think they will learn about.

3. Point out the glossary. Make use of the glossary throughout all aspects of teaching.

4. Introduce the lesson by explaining that the class will be starting a fruit fly population. Demonstrate the preparation of the food mix (T-42). Allow the children to make their own food mix and place it in the containers. Discuss the need to keep things moist. Have the children label their containers.

5. Allow the students to place their containers where they think the fruit flies will grow best. These should be placed out of the sun, and away from drafts.

6. Assist the children in daily observations of their containers, with the use of magnifying glasses. Bring attention to eggs, larva, pupa, and adult flies whenever possible. Have the children draw their observations and label. These may be used later for sequencing activities.

7. Have students daily record the number of observed fruit flies per container. Discuss why some bottles have fruit fly populations and others don't, in terms of environmental factors.

8. Read "Start a Fruit Fly Population," and "Fruit Fly Growth" or teacher may paraphrase. Discuss the procedures and the questions. Language and identification cards may be used to facilitate communication.

DESIRED LEARNING OUTCOME: The students should be able to:

1. place containers where environmental factors (light, air, and temperature) are best suited for fruit fly growth.
2. identify, describe, and list growth stages of fruit fly population.

* * *

INTRODUCTION: Lesson Cluster 1A-2 Preparing for Later
Page T-38/S-10 Start a Bean Population (40 min.)

PURPOSE: To introduce the concept of environmental factors best suited to the growth of bean seeds.

ADVANCE PREPARATION: Materials
- bush
- string
- lima bean seeds (enough for every child with some left over to supplement ones that didn't grow)
- soil
- small pebbles
- pot (styrofoam cups will do)
- pans (frozen food pans etc.) to hold potted plants
- centimeter sticks to measure plant growth

Language Cards/Key Signs
factor
bean name
centimeter stick
weeds
pebbles

1. Prepare simple graphs by centimeter and day, for the children to record growth.

2. Have children describe changes in bean growth from drawings made of germinating bean seeds over the past 3 days. Have the children read "Bean Plant Growth" student page 14. Discuss the growth of bean plants in terms of structures and stages.

TEACHING SUGGESTIONS:

1. Display all of the materials to the students. Have each student write identification cards (with appropriate determiners) as the materials are introduced.

2. Have the students read the directions from "Start a Bean Population" or teacher may paraphrase. The teacher should follow the instructions as they are read, demonstrating correct procedure.

3. Distribute the materials to the students and have them plant 3 cups of seeds each. Have the students level their cups.

4. Upon completion, allow the students to place their cups where they think the beans will grow best. Ask them to explain why: use the language cards to facilitate the discussion. List factors that may affect bean plant growth on the board.

5. Record the planting data on the class calendar.

6. Re-read "Start a Bean Population" as a class and discuss the questions. Ask the students to predict what day the plants will appear. Make a prediction chart (students name and prediction) and hang in room.

7. Record growth of plants in pots on a daily basis for 7 days. If no growth, record 0 centimeters until plants begin to appear.

8. Have children list changes in bean growth from drawings made of germinating bean seeds over the past 3 days. List on board.

9. Have students look at the pictures on page 14. Look at each picture and observe growth of bean plants. Have students identify the different parts of the bean plants and list on board.

10. Have students read page 14 or teacher may paraphrase. Discuss growth of bean plants in terms of structure and stages.

11. Record the appearance data of plant above soil on the class calendar.

DESIRED LEARNING OUTCOME: The students should be able to:

1. plant bean seeds,
2. place the cups where they think the plants will grow best,
3. explain the placement of their cups,
4. list some factors affecting bean plant growth.

****

DEVELOPMENT: Lesson Cluster 1A-2 Preparing for Later
Page T-39/S-11 Start Other Bean Plants (25-35 min.)

PURPOSE: To extend the students knowledge of general environmental factors to an investigation of heat.
To introduce the students to organized experimentation of the variable of heat and its affects on the growth of bean seeds.

PREREQUISITES:
1. A concept of temperature (determined by teacher observed use of temperature words, i.e. hot, cold, etc.)
2. An ability to appropriately plant seeds.

ADVANCE PREPARATION: Materials
- aluminum foil
- bean seeds
- metal Celcius thermometer (three more than children in class)

1. Arrange for class access to a stove and a refrigerator.
2. Develop simple graphs, in centimeter and days for the children to record growth.

Language Cards/Key Signs
degree Celcius
heat
temperature
experiment

Identification Cards
graph
aluminum foil

TEACHING SUGGESTIONS:

1. Have students make daily record of flies and bean growth from previous days activities.

2. Introduce the lesson by explaining what an experiment is. Explain that the class will experiment with heat and bean seeds.

3. Have the children select bean seeds and wrap them in aluminum foil, for a total of three packages.

4. Retire to the school cafeteria. Place a thermometer and packages of bean seeds in the freezer. Place a thermometer and packages of beans on a table. Place a thermometer and packages of beans in the oven (set for 212° F).

5. During the thirty minute wait, allow the children to experiment with other thermometer, reading temperatures in degrees Celcius in the sun, shade, under their arm, and other ways invented by the children.

6. After thirty minutes, retrieve the seeds, and record the temperature under which they have been placed.

7. Return to the classroom, plant the seeds. Be careful to distinguish which seeds underwent which temperatures by labeling the pots.

8. Record planting data on the class calendar. Record growth on the daily graph, in centimeter.

9. When it becomes apparent as to which seeds will grow, read and discuss "Start Other Bean Plants." (approximately 2-3 weeks)

DESIRED LEARNING OUTCOME: The students should be able to 1. plant seeds; 2. observe, measure, and record growth, and 3. explain why some seeds didn't grow in terms of heat.

****

APPLICATION: Lesson Cluster 1A-2 Preparing for Later
Page T-44/S-14 Bean Plant Growth (40 min.)

PURPOSE: To introduce the children to the concepts of stages of growth, through observing bean plants.

ADVANCE PREPARATION: Materials - lima beans
- clear containers
- water

1. Allow the children to develop identification cards as they observe the structures.

2. Soak seeds.

Language Cards/Key Signs
growth
cycle stages
structures (parts)
sprout

Identification Cards

TEACHING SUGGESTIONS:

1. Discuss with the children about observing the growth of bean plants.

2. Have each child fill their container with water and place seeds in it over night.

3. Allow the root of the beans to germinate and sprout. Observe the daily changes of the seeds, discussing the changes with the children.

4. Have the children take a part one seed per day for 3 days and draw the different stages and label the structures.

LEARNING OUTCOME: The students should be able to:
1. identify bean plant structures, and
2. describe the growth of bean plants.

****

ENRICHMENT: Lesson Cluster 1A-2 Preparing for Later
Page T-42 A Cricket Environment (30-40 min.)

PURPOSE: To provide further opportunities for observation of environmental factor for animal and plant growth.

ADVANCE PREPARATION: Materials - a terrarium
- cover screen
- soil (representing substrate layering)
- terrarium plants
- crickets
- apples (or oatmeal moistened)
- jar lid (for water)
- pebbles

Language Cards/Key Signs
moisture
stages
heat
egg

nymph

adult
crickets
layers

Identification Cards
terrarium
plant names
humas (peat)
cover screen
pebbles

TEACHING SUGGESTIONS:

1. Have students make daily records of flies and bean growth from previous days activities.

2. Display the materials, using identification cards and matching to attach names.

3. Discuss the procedure of setting up a terrarium.

4. Allow the children to assist:
   a. pouring in the soil (labeling layers of composition) pebbles, sand, humas (peat) soil
   b. plant the plants and water them
   c. put the jar lid in and fill it with water
   d. place the moistened oatmeal in
   e. put the crickets in
   f. cover the terrarium
   g. place it in the classroom.

5. Discuss the procedures with the class. Ask them to predict what will happen to the crickets.

6. Assist in daily observations of the status of the cricket population, pointing out eggs, nymphs, young crickets, and adults. Have students draw observations and label. These may be used later for sequencing activities.

7. Discuss factors in the crickets' environment (light, water, air, temperature, food plants, etc.). List on board.

8. Discuss the behavior of the crickets (drinking, hopping, eating, breeding, mating).

9. Encourage weekly observation, with the use of magnifying glasses, of the terrarium.

DESIRED LEARNING OUTCOME: The students should be able to:
1. describe the procedure of setting up a terrarium,
2. name factors in the environment of the crickets, and
3. describe the life cycle of crickets.

****

Level 4 Unit 4 Environments

Part A Interactions In An Environment, Lesson Cluster 1A-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-52	Development	Seeds and Heat	15-25 min.
T-50	Introduction	Bean Plants and Water	20-30 min.
T-54	Development	Fruit Flies and Heat	20-30 min.
T-56	Development	Another Kind of Record	30-35 min.
T-60	Evaluation	Recognizing Environmental Factors	20-30 min.
T-45	Evaluation	Keeping Track	45 min.

B. MATERIALS: See list on page T-47.

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction in a Population, is appropriate for use in this unit.

DEVELOPMENT: Lesson Cluster 1A-3 Observing Factors
Page T-52/S-18 Seeds and Heat (15-25 min.)

PURPOSE: To review the concept of the effects of heat on the growth of bean plants.

PREREQUISITES: Completion of "Start Other Bean Plants."

ADVANCE PREPARATION: 1. Draw a chart on the board with temperatures from "Start Other Bean Plants" across the top and centimeters down the side.

Language Cards/Key Signs
the bean plants
temperature

Identification Cards

TEACHING SUGGESTIONS:

1. Have children make daily record of number flies and bean growth experiments.
2. Have students bring their graphs from "Start Other Bean Plants" to a group in front of the board.
3. Have each student record the last growth measurement of his/her seeds in the appropriate column by writing his/her name.
4. Discuss the effects of temperature differences on the seeds and the growth of bean plants, deciding which is most suited for bean plant growth.
5. Read and discuss "Seeds and Heat" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: The students should be able to state the heat factor best suited to the growth of bean seeds.

****

INTRODUCTION: Lesson Cluster 1A-3 Observing Factors
Page T-50/S-16 Bean Plants and Water (20-30 min.)

PURPOSE: To introduce the concept of volume and the concept of measurement of water as an environmental factor affecting growth of bean plants.

PREREQUISITES: Completion of "Start a Bean Population".
Understanding of the concept of volume.

ADVANCE PREPARATION: Materials - graduate cylinder
- milliliter (ml)
- cubic centimeter
- liter

Language Cards/Key Signs
the bean plants
make observations
experiment
graph paper
measure
volume
measurement

Identification Cards
graduated cylinder
milliliter (ml)
cubic centimeter
liter

TEACHING SUGGESTIONS:

1. Have students make daily record of number flies and bean growth from previous days activities.
2. Allow the children time to play with the graduated cylinders, measuring different volumes. Use the identification and language cards to assist the children in using measurement vocabulary.
3. Give each student a number of mL. (example 52 mL.) Using colored water, have student correctly fill the graduated cylinder to that number to check understanding of the use of a graduated cylinder.
4. Have the children bring their bean plants from "Start a Bean Population" to a central table. Explain that they will be conducting an experiment with beans and water.
5. Have the children decide on three volumes of water (one for each cup) that they will use to water their plants. Have the students write this amount on each cup.
6. Distribute graphs, one for each water volume (3 per child) for daily recording of growth. Keep ongoing observations and record daily the growth of the plants.
7. Discuss the effects of varying amounts of water on bean plants with the class.
8. Read and discuss "Bean Plants and Water" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: The students should be able to:
1. measure different volumes of water, and
2. determine the amount of water best suited for bean growth.

****

DEVELOPMENT: Lesson Cluster 1A-3 Observing Factors
Page T-54/S-19 Fruit Flies and Heat (2-30 min.)

PURPOSE: To extend the concept of heat as an environmental factor on fruit fly activity.

PREREQUISITES: Completion of "Start a Fruit Fly Population" and "Fruit Fly Growth" (as a combined lesson).
Concept of light as a heat producer.

ADVANCE PREPARATION: Materials - 3 desk lamps
- 3 Celcius thermometers

1. Inform custodial staff not to move or turn off the desk lamps as they are part of an experiment.

Language Cards/Key Signs
fruit flies
vial

Identification Cards
desk lamps
Celcius thermometer
experiment

TEACHING SUGGESTIONS:

1. Have students make records of number flies and bean growth from previous days activities.
2. Have children measure temperature at varying distances from the desk lamps.
3. Have the children place the maps and thermometers such that the thermometers read Room temperature and a higher temperature 24-30° C.
4. Place the one fruit fly vial at each temperature and observe the activity of the fruit flies over a series of days.
5. Discuss the effects of heat on the activity of the fruit flies.
6. Read and discuss "Fruit Flies and Heat" at a later time or teacher may paraphrase.

DESIRED LEARNING OUTCOME: The students should be able to observe and describe the effects of heat on fruit fly behavior, and determine heat factors best suited to fruit fly activity.

****

DEVELOPMENT: Lesson Cluster 1A-3 Observing Factors
Page T-56/S-20 Another Kind of Record (30-35 min.)

PURPOSE: To introduce the students to representation of population growth on a histogram.

PREREQUISITES: Conjunction of this lesson with Lesson Cluster 1A-2 "Start a Fruit Fly Population" and "Fruit Fly Growth."

ADVANCE PREPARATION: 1. Obtain graph paper and record "weeks" on the abscissa and "numbers of fruit flies" on the ordinate.

Language Cards/Key Signs
graph
histogram
range
record (noun/verb)

Identification Cards

TEACHING SUGGESTIONS:

1. Have students make daily record of number flies and bean growth from previous days activities.

2. Introduce the histogram to the students. Explain to them the parts of the graph. Explain that they will be counting the number of fruit flies once a week.

3. Assist the children in counting and recording the numbers of fruit flies in their containers, once a week, for six weeks. Demonstrate the recording on the histogram on the board. As the children are able to perform by themselves, serve only as a monitor.

4. Discuss the histograms in terms of the rise and decline of the population. Point out the low and high population points. Demonstrate how to find the range on the teacher's histogram.

5. Have the children determine their own population ranges.

6. Read and discuss "Another Kind of Record" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should be able to record and interpret data they have gathered on the histogram.

****

EVALUATION: Lesson Cluster 1A-3 Observing Factors
Page T-60/S-23 Recognizing Environmental Factors (20-30 min.)

PURPOSE: To evaluate student performance in relation to:
1. identifying the environmental factors,
2. making a histogram and recording growth,
3. listing environmental factors that affect the growth of a population.

PREREQUISITES: Completion of Lesson Cluster 1A-3.

ADVANCE PREPARATION: Materials - graph paper

Write the following on the board to replace question #2 in the text:

Mrs. Smiths' class had a fruit fly population also. Here is what happened with John's fruit flies.

Weeks	# of fruit flies
Week I	0
Week II	4
Week III	9
Week IV	15
Week V	10
Week VI	7

Directions:
1. Make a histogram for John.
2. What is the range of John's population (fruit fly)?
3. List 2 factors that might have changed John's fruit fly population.

TEACHING SUGGESTIONS:

1. Have students make record of number of flies and bean growth from previous days activities.

2. Assist the students in reading the "Wrap-Up," and question #1. Teacher may paraphrase. Have students look at each picture and find the environmental factor that changed the picture. List on answer sheet.

3. Distribute graph paper.

4. Have students read #2 from blackboard (see advanced preparation) or teacher may paraphrase.

5. Allow students time to complete required work.

****

EVALUATION: Lesson Cluster 1A-2 Preparing for Later
Page T-45/S-15 Keeping Track (45 min.)

PURPOSE: To evaluate student performance.

1. listing environmental factors affecting bean plant growth,
2. listing environmental factors affecting fruit fly growth,
3. making a record of bean plant growth, and
4. making a record of fruit fly growth.

ADVANCE PREPARATION:

1. Previous assistance in recording plant and animal growth.

TEACHING SUGGESTIONS:

1. Have students make records of # flies and bean growth from previous days activities.

2. Have the students read page 15, number 1 (or teacher may paraphrase) and perform the task. Illustrate how to set up their papers on the board.

3. Through days of previous observing of the children and assisting their recording (graphing) of plant and animal growth, discuss with each child and record on their test paper how well they are able to record by themselves.

4. Further opportunity for data recording will be make available. Communicate this to children still having problems with this task, and reinforce those children who have mastered it.

****

Level 4 Unit 1 Environments

Part A Interactions in an Environment, Lesson Cluster 1A-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-24-26	Preparation Activity	Planting Grass	30 min.
	Introduction	A Factor Search-Finding Factors	20-30 min.
T-28	Development	Adding up the Factors	20-30 min.
T-27	Development	Factors for People	15-25 min.
T-29-30	Application/Enrichment	Environments Everywhere/ Special Factor Search	30-40 min.
T-31	Evaluation	Recognizing Environments	20-30 min.

NOTE: Introduction - both 1A and 1B have been collapsed into an introduction activity.
Development - the two development lessons have been reversed.
Application and Enrichment - both have been collapsed into an extended lesson where the Enrichment becomes a mandatory part of the application.
Evaluation - some modification to allow the children some practice samples.

B. MATERIALS: Add the following to list on page T-21:
- bottom half of plastic gallon containers
- soil
- grass seed
- water
- newspaper
- pencils
- measuring containers

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction in a Population, is appropriate for use in this unit.

PREPARATION ACTIVITY: This is needed for lesson T-83 Plants and Erosion. Must plant grass now so it will be ready when needed 10 days from now.

ADVANCE PREPARATION: Materials
- bottom half of a plastic bleach bottle
- soil
- pencil
- grass seed
- water
- newspaper
- measuring containers

TEACHING SUGGESTIONS:

1. Explain to the students that they need to plant some grass for a future lesson.
2. Divide class into pairs. Distribute 2 planters and a pencil to each group.
3. Have the students poke 10, evenly spaced holes in the bottom of each planter with a pencil.
4. Have students put 3 cups of soil in each planter. They are to label one planter GRASS and then plant grass in it. Have them sprinkle a lot of grass seeds so a lot of grass will grow. Have them put their names on the planters.
5. Show the student where to put the containers.
6. Explain to the students they will need to water their seeds everyday - Demonstrate how to sprinkle water gently over seeds.

****

INTRODUCTION: Lesson Cluster 1A-1 What Is An Environment?
Page T-24-26/S-3-5 A Factor Search (20-30 min.)

PURPOSE: To introduce: the term factor in relation to environments and concept of interactions of organisms with their surroundings.

PREREQUISITES: concept of "part and whole"
concept of "same and different"

ADVANCE PREPARATION: Materials - five plants
- five animals

1. Place plants and animals where conditions will be favorable to their life and growth. Try to represent variety in selection of organisms.
2. Insure that the students are capable of using the terms property, organism, surrounding, and object appropriately, either through modeling or direct instruction.

Language Cards/Key Signs
factor
environment
property
interact
glossary
organism
surrounding
object

Identification Cards
(with appropriate determiners, should be attached close to the organisms.)

TEACHING SUGGESTIONS:

1. Have students make daily record of number flies and bean growth from previous activities.
2. Discuss the first unit of study in terms of plants, animals, and their interaction with their surroundings. Tie the discussion to the children and how they interact with their surroundings. Define interaction as something that happens to make a change in one or more objects or organisms. Have students look at the pictures on page 3 and identify organisms, and factors in the picture.
3. Observe the collected plants and animals. Discuss their properties. List on board. Discuss their interaction with the environment in terms of their needs and list on board. Have students read over their discoveries on the board.

4. Observe living organisms around the schoolyard. Discuss their interaction as in #3.

5. Have the students read "A Factor Search" or teacher may paraphrase. Make a list on the board of "Same Factors" and "Different Factors." Discuss organisms chosen by the children.

6. Conduct a discussion of the questions on page 4 of their books.

7. Assign page 5 for homework. Teacher should first paraphrase the lesson and help students to name factors found in the pictures. Then assign for homework.

8. Discuss the childrens' homework papers the following day, as in #4 and #5 above.

DESIRED LEARNING OUTCOME: The students should identify the following factors:

light	air	cold
dark	heat	other organisms

* * *

DEVELOPMENT: Lesson Cluster 1A-1 What Is An Environment?
Page T-28/S-7 Adding Up The Factors (20-30 min.)

PURPOSE: To develop an operational definition of the term environment.

ADVANCE PREPARATION: Materials - Mounted pictures of various environments.

Language Cards/Key Signs
environment
organism
factor
interact

Identification Cards
heat
organisms
light
air
water
dark
sun
shade

TEACHING SUGGESTIONS:

1. Have students make daily record of number flies from previous activities.

2. Have the students observe pictures of various environments in terms of the environmental factors. Use the Identification and Language Cards to facilitate a class discussion.

3. Encourage careful observation. Upon completion of the discussion, have the students plan and put up a bulletin board on environmental factors and environments.

4. Have the students read "Adding up the Factors" or teacher may paraphrase.

5. Conduct a class discussion of the questions, and develop a class definition of environment. Place this definition on the sentence strip on the bulletin board.

DESIRED LEARNING OUTCOME: The students should be able to identify factors which an organism interacts as its environment.

* * *

DEVELOPMENT: **Lesson Cluster 1A-1** What Is An Environment?
Page T-27/S-6 Factors for People (15-25 min.)

PURPOSE: To relate interaction of organisms with factors in their surrounding to human beings.
To evaluate factors as "helpful" or "harmful."

Language Cards/Key Signs
helpful
harmful
factors

Identification Cards
(make one card for each factor the children identify)

PREREQUISITES: classification of variables
understanding of the term "factor"

ADVANCE PREPARATION: Materials - old magazines
- drawing paper
- scissors

TEACHING SUGGESTIONS:

1. Have students make daily record of number flies from previous activities.
2. Introduce the lesson by observing people interacting with their environment.
3. As each student identifies a factor have him/her make an identification card.
4. In the classroom, discuss factors you and the children have identified as helpful or harmful to people. Add more factors, with identification cards, should more be necessary.
5. Distribute old magazines and drawing paper. Have the children cut out pictures, or draw them, depicting environments. Have each student discuss his/her pictures and the "helpful" or "harmful" factors that can be identified. List these on the back of the picture.
6. Discuss "harmful" and "helpful" factors in terms of other plants and animals.
7. Have the students read "Factors for People" or teacher may paraphrase. Use class discussion for the questions.
8. Have children describe changes in fruit fly populations at the two temperatures recorded on previous days. Have the children read "Fruit Flies and Heat" on page 19 or teacher may paraphrase.

DESIRED LEARNING OUTCOME: The students should be able to identify helpful and harmful factors in their surroundings.

****

APPLICATION: Lesson Cluster 1A-1 What Is An Environment?
Page T-29/S-8 Environments Everywhere (30-40 min.)

PURPOSE: To allow the students an opportunity to view special environments and environmental factors suited to the unique needs of particular organisms.

ADVANCE PREPARATION: Materials -

1. Make films, filmstrips, books, magazines and pictures of a variety of environments available for student viewing. Include samples from all major environments.
2. Develop identification cards for those environments and environmental factors of particular student interest.

Language Cards/Key Signs

Identification Cards
(see Advance Preparation)

TEACHING SUGGESTIONS:

1. Allow the students sufficient time to view the materials (e.g. arctic, tropic, desert, temperate, shallow ocean, deep ocean, atmosphere). The social studies teacher may be helpful with materials.

2. Allow each student time to explain his/her choices to the class in terms of environmental factors present.

3. Lead a discussion of similar and different environmental factors between the variety of environments discussed.

4. Discuss common factors for all living objects and make a list on the board.

5. Have the students read "Environments Everywhere" or teacher may paraphrase and answer the questions on their own.

6. Conduct a class discussion of the reading and questions.

DESIRED LEARNING OUTCOME: The students should be able to identify the environmental factors suited to the special needs of particular organisms.

****

EVALUATION: Lesson Cluster 1A-1 What Is An Environment?
Page T-31 Recognizing Environments (20-30 min.)

PURPOSE: To evaluate student performance in relation to:
1. finding environmental factors hidden in a puzzle,
2. drawing pictures of their home environment, and listing environmental factors,
3. listing common environmental factors,
4. listing environmental factors helpful to organisms in a deep sea environment.

PREREQUISITES: Competence in finding words hidden in a word puzzle.

ADVANCE PREPARATION:

1. Develop two or three word puzzles and allow the children an opportunity to find hidden words.
2. Copy the puzzle in Appendix A, page T-474 to provide each student a copy for the evaluation.

TEACHING SUGGESTIONS:

1. Distribute copies of the word puzzle. Have the students open their books to page 9. Explain that they are to find environmental factors and circle that word in the puzzle.

2. Teacher should paraphrase #2.

3. Omit Evaluation question #3 - students may be unable to list factors that help a diver due to language (ex. helmet, mask, oxygen tank, flippers - students do not know these terms).
   Teacher may substitute a picture from a magazine of an environment with organisms. Students would still need to list factors in the picture.

4. Allow students time to complete the evaluation.

5. Mark correct answers only, while the student watches.

6. Make sure all students respond appropriately to most of the questions before proceeding.

7. Lesson 4 may be repeated if the teacher feels the students need more instruction.

****

Level 4 Unit 1 Environments

Part B Populations Change Environments, Lesson Cluster 1B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-68	Introduction	Mealworms and Air	20-30 min.
T-70	Development	Changes That Help	20-30 min.
T-71	Development	Changes That Harm	15-25 min.
T-72	Application	Starfish Attack	15-25 min.
T-74	Enrichment	Mealworm Growth	20-30 min.
T-75	Evaluation	Animals Change Environments	20-30 min.

NOTE: Changes that Help and Changes That Harm have been combined into one lesson.

B. MATERIALS: See list on page T-65.

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction in a Population, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1B-1 Animals Cause Changes
PageT-68/S-26 Mealworms and Air (20-30 min.)

PURPOSE: To introduce the concepts of environmental change caused by the interaction of animals and factors in their environment.

ADVANCE PREPARATION: Materials
- 1 vial for each child
- water based brom thymol blue (BTB), approximately 300 milliliters
- 50 mealworms
- tape
- cardboard
- newspaper
- Directions for constructing vial with mealworms on the board.

Store the mealworms in a refrigerator, and the BTB in a safe place away from the children.

Language Cards/Key Signs
measure
change
handle
danger
chemical
safety

Identification Cards
bromthymol blue (BTB)
mealworms
vial
cardboard
masking tape

graduated cylinder

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students look at the picture on page 25. Explain that we have been learning about how plants and animals can change the environment. Ask the question: What is being changed in this environment?

2. Have students turn to page 26. Introduce the lesson by explaining that the children will be conducting an experiment and they must observe carefully. Display the materials, naming them (use identification cards) and describing that BTB is a dangerous chemical and students must be careful. Stress safety.

3. Distribute the newspapers and have the students cover their desks with it.

4. Mix 20 drops of BTB into 250 mL of water. Have the students describe what they see. Have students half fill their vials with BTB. Stress safety.

5. Refer class to the picture on page 26. Demonstrate how to make the vial referring to directions on the board as you go along.

6. Allow students to construct vial. Help when necessary.

7. When vial is completely constructed, have the students place several mealworms inside the vial on top of the cardboard. Put cap back on vial.

8. Have students observe their vials for about 10 minutes. Discuss their observations.

9. Help students to understand that it had been the mealworms that caused a change in the color of the BTB. Get them to determine that air is the changed factor.

10. Have students clean up and wash their hands.

11. Read and discuss page 26 or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Ability to observe evidence of a change in the air factor of mealworms caused by the interaction of the mealworms and the air in their environment.

* * *

DEVELOPMENT: Lesson Cluster 1B-1 Animals Cause Changes
Page T-70/S-27 Changes That Help and Page T-71/S-28 Changes That Harm (55 min.)

PURPOSE: To extend student learning about environmental changes caused by animals to specific changes that are helpful to other populations in the same environment.

PREREQUISITES: Outside observations.

ADVANCE PREPARATION:

1. See Lesson 3 and combine it with this Lesson 2.
2. Conduct a field trip around the school pointing out animals carrying out their daily activities.
3. Have the students describe what they are doing. Allow the children to determine for themselves if they have positive or negative feelings about what animals are doing. Help the children to translate these feelings into the idea of "helpful" or "harmful". Emphasize the helpful aspects.

Language Cards/Key Signs
an animal
helpful
harmful

Identification Cards
(various animals observed)
(activities observed)

TEACHING SUGGESTIONS:

1. Have the students look at the pictures on page 27. Discuss each picture through teacher paraphrasing of the questions.
2. Have the students read the first paragraph on page 27 or teacher may paraphrase.
3. Follow teaching suggestions #1 and 2 for page 28.
4. Have students help make a chart on the board listing some changes animals make that help/harm other populations. Encourage students to think of different examples other than those illustrated in the book.

DESIRED LEARNING OUTCOME: The students should identify environmental changes made by animals that are helpful to other populations in the same environment.

****

APPLICATION: Lesson Cluster 1B-1 Animals Cause Changes
Page T-72 Starfish Attack

PURPOSE: To enable students to apply what they have learned about environmental changes caused by animals to the study of a problem created by such a change.

PREREQUISITE: Exposure to fresh and preferably pet shop salt water aquaria.

ADVANCE PREPARATION: Materials - films*
- filmstrips and books about the ocean, reffs in specific

1. Allow the children at least 2 or 3 class periods to watch and discuss the films/strips and browse through and discuss the books/pictures.

*Note: This lesson is very hard to get across without the help of some visual media (i.e. films or filmstrips).

Language Cards/Key Signs
a marine biologist
a reef
some coral polyps
the Great Barrier Reef
some coral
a crown-of-thorns

Identification Cards
(variety depending on the interest of the children)
globe
Australia

TEACHING SUGGESTIONS:

1. After viewing the films/strips, reading the books, locating reefs around the world (Australia/Great Barrier Reef in particular), have the students turn to page 29 and look at the picture on the left.
2. Point to the word Marine biologist on the board. Explain that the man they see in the picture is a Marine biologist. His job is to study organisms in salt water environment.
3. Refer to the picture on the right on page 29. Explain how coral reefs are made. Teacher may now paraphrase the text on page 29.
4. Refer to the picture on page 30. Explain the battle between the coral polyps and starfish. Be sure students understand the interactions between the 2 organisms.

Teacher may now paraphrase the text on page 29.

5. Have students decide which organism causes a harmful change and which causes a helpful change.

6. Discuss the questions on page 30 through teacher paraphrasing.

DESIRED LEARNING OUTCOME: Students should be able to apply what they have learned about helpful and harmful environmental changes to a current problem created by an animal, population.

****

ENRICHMENT: Lesson Cluster 1B-1 Animals Cause Changes
Page T-74 Mealworm Growth (20-30 min.)

PURPOSE: To provide an opportunity for on-going observation of a specific population and its interaction in and with its environment.

ADVANCE PREPARATION: Materials
- mealworms
- magnifying glass for each student
- 1 shallow glass container
- cheesecloth
- dry cereal
- containers
- BTB
- paper
- apple slice

Language Cards/Key Signs
growth
a grain beetle
development
stages
cheesecloth

Identification Cards
a larvae

1. Allow the students to transfer their mealworms from lesson 1, along with the food to this central container.
2. Place two vials of BTB solution (one green one copper) into the container. Cover the container with cheesecloth (to retard evaporation).
3. Place a crumpled piece of paper in the container. Eggs will be laid on this.

TEACHING SUGGESTIONS:

1. Review the growth stages of the fruit flies. Explain that mealworms also have growth stages.

2. Have the students set up their mealworm environment. Have the directions on the board.
   a) Get a container from the supply table.
   b) Half fill the container with dry cereal.
   c) Add 1 slice of apple.
   d) Get mealworms from central container and place 5 to 10 in your container.
   e) Cover container with cheesecloth.
   f) Place your container in a warm dark place.
   g) When adult beetles hatch, crumple up paper towel and place in container.

3. Explain each step, and that the class will observe changes over time. Keep a log next to the container and several magnifying glasses.

4. Each time a child observes a change in the environment, allow the child to record (in original language) what is observed, their name and the date.

5. Periodically pull the class together and read through the log of changes. Allow the children to discover the pattern of the grain beetles' life cycle.

6. Explain long term assignment - As students observe a change in the mealworm growth - have them draw their observations on paper in their notebook. Have them label any stages they observe. All notebooks will be collected after mealworms go through all stages.

DESIRED LEARNING OUTCOME: The students will be able to identify changes in the environment caused by larvae, pupae, adults, and eggs of the grain beetle. The students should also be able to describe the life cycle of the grain beetle.

****

EVALUATION: Lesson Cluster 1B-1 Animals Cause Changes
Page T-75/S-31 Animals Change Environments (20-30 min.)

PURPOSE: To evaluate students' performance in relation to
1. listing helpful/harmful changes animals make in their environment;
2. drawing pictures of how animals change their environments.

PREREQUISITE: Extensive outside observation of a variety of environments/habitats.

ADVANCE PREPARATION:

1. Make a ditto of Helpful/Harmful columns for the children to write their response on.
2. Produce pictures of the rat, cockroach, pigeon, and raccoon in their environment. The children can draw on or indicate the changes the animals make.

TEACHING SUGGESTIONS:

1. Read through the evaluation, and describe what the children are to do. The teacher should paraphrase question #1 as follows: Explain that the list you will sign are ways that animals can change their environment. After reading each phrase ask student if this helps or harms other population. Have students put their responses under the appropriate column.

2. Paraphrase question #2 to suit language level of child. If necessary do an example on the board to show students what is necessary. Then have students think of another example and illustrate on their paper.

3. Allow the children time to take the evaluation.

4. Correct each paper with the individual student, marking only correct responses.

5. Record the number correct.

****

Level 4 Unit 1 Environments

Part B Populations Change Environments, Lesson Cluster 1B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-80	Introduction	Plants and Water	30-40 min.
T-81	Enrichment	Plants and Air	25-35 min.
T-83	Application	Plants and Erosion	30-40 min.
T-85	Application	Soil Erosion	20-30 min.
T-82	Development	Changes by Plants	20-30 min.
T-86	Evaluation	Plants Change Environments	20-30 min.

NOTE: Development Changes by Plants is moved before the evaluation as a culmination activity.

B. MATERIALS: See list on page T-77.

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction in a Population, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1B-2 Plants Cause Changes
Page T-80/S-32 Plants and Water (30-40 min.)

PURPOSE: To introduce the concepts related to environmental changes caused by interaction of plants in their environments.

PREREQUISITES: Cluster A, ability to measure in centimeters and centiliters.

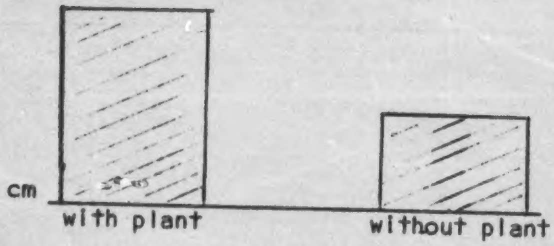
ADVANCE PREPARATION: Materials
- newspaper
- soil
- collecting jars (2 for each pair of children
- graduated cylinder (1 for each pair of children)
- plant pots (cups) (3 for each pair of children)
- bean plants from Cluster 2 Part A

Language Cards/Key Signs
an experiment
constant variable
a centiliter
measurement
same
different

Identification Cards
cup (pot)
some soil
a graduated cylinder
a collecting jar

1. A two column, "with plant", "without plant" bar graph should be drawn on the board.

Example: BAR GRAPH



Note: A chart could be used instead of a graph.

TEACHING SUGGESTIONS:

1. Have all materials placed on a table. Divide the students in pairs. Have them collect 1 cup full of soil, their bean plant, a graduated cylinder, two empty cups, two collecting jars, and some newspaper. Allow set up time. Have the students fill the 2 empty cups with the equal amounts of water.
2. Have students make drainage holes in the cup filled with soil that are exactly the same as the holes in the cup with the bean plant.
3. One student should hold the bean plant and soil cups over the separate collecting jars while the partner pores the water through both at the same time.* *Place the cup of soil over 1 collecting jar and the bean plant over the other.
4. Have the students measure and report centimeter differences in the heights of water in the collecting jars.
5. Write the heading "Without Plants" and "With Plants" on the board. Check under the appropriate column as each group reports which cup more water went through.
6. Discuss the findings with the class after everything is cleaned up.
7. Read and discuss "Plants and Water" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: The students should be able to describe that more water runs through soil without plants than with plants as an environmental factor.

****

ENRICHMENT: Lesson Cluster 1B-2 Plants Cause Changes
Page T-81 Plants and Air (25-35 min.)

PURPOSE: To provide an opportunity to investigate changes caused by plant interaction with air as an environmental factor.

PREREQUISITE: Understanding of what an "indicator" is.

ADVANCE PREPARATION: Materials - 10 drops: 110mL solution of BTB
- clear plastic bags (big enough to put over bean plants)
- one petri dish per plant (can be done with bean sprouts and Lesson B-1 set-up)

Language Cards/Key Signs
environmental factor
to investigate

Identification Cards
apparatus cards

TEACHING SUGGESTIONS:

1. Discuss with the students that they will be investigating the interaction of plants with the environmental factor of air.

2. Place the BTB solution into the petri dishes and place the plants and the petri dish in the plastic bag. Seal the bag.

3. Observe changes in the BTB.

4. Discuss the reaction of BTB as an indication of plant interaction with air, after the children have cleaned up and washed.

DESIRED LEARNING OUTCOME: The students should describe evidence of change in the air factor caused by sprouting beans in terms of color changes in BTB.

****

APPLICATION: Lesson Cluster 1B-2 Plants Cause Changes
Page T-83/S-34 Plants and Erosion (30-40 min.)

PURPOSE: To apply student knowledge of wind (air) and water as environmental factors/variables to soil erosion.

PREREQUISITES: Investigation of hillside gullies/ravines and open tilled fields.

ADVANCE PREPARATION: Materials - For each child have:
- sod (or have children plant their own grass)
- tray
- newspaper
- measuring cups
- planters with grass and soil (from previous lesson)
- water

Language Cards/Key Signs
erosion

Identification Cards

Make sure the prerequisites are fulfilled for all children. First hand observation or pictures may be used.

TEACHING SUGGESTIONS:

1. Cover desk with newspaper. Place a planter with grass on one tray; the planter with only soil on another tray.

2. Set the erosion trays at a tilt, one tray will have grass plants, the other only soil.

3. Pour 1 cup of water over both trays so that it creates a run-off. Measure how much soil is washed away from each one.

4. Discuss the results with the children. Write the term erosion on the board. Discuss the definition.

5. Repeat the experiment when the soil is dry, outside on a windy day, using no water.

6. Discuss the results with the children.

7. Read and discuss the text, Plants and Erosion, page 34 or teacher may paraphrase.

DESIRED LEARNING OUTCOME: The student should be able to discuss the effects of water and wind (air) on planted and unplanted soil.

****

APPLICATION: Lesson Cluster 1B-2 Plants Cause Changes
Page T-85/S-35 Soil Erosion (20-30 min.)

PURPOSE: To enable the students to apply their knowledge about the environmental factors of wind and water on soil to a variety of situations.

ADVANCE PREPARATION: View filmstrips or films on erosion.

TEACHING SUGGESTIONS:

1. View media on erosion.

2. Review the term erosion.

3. Have the students look at the pictures on page 38. Discuss each picture through teacher paraphrasing questions on page 35.

4. Read and discuss first paragraph on page 35 or teacher may paraphrase.

DESIRED LEARNING OUTCOME: The students should describe the amount of wind/water erosion evidence in the pictures as a function of the existence of plants.

****

DEVELOPMENT: Lesson Cluster 1B-2 Plants Cause Changes
Page T-82/S-33 Changes By Plants (20-30 min.)

PURPOSE: To extend student learning to specific changes caused by plants as helpful or harmful to other populations.

PREREQUISITE: Extensive outdoor experience/field trips: dry ground, wet ground, shade and a variety of plants.

ADVANCE PREPARATION:

Spend 3 or 4 class times observing the variety of plants outdoors and discussing them with the children.

TEACHING SUGGESTIONS:

1. Allow time for students to observe pictures on page 33. Discuss what they see through teacher paraphrasing of questions.

2. Discuss the questions and answers within the class.

DESIRED LEARNING OUTCOME: The students should be able to identify some helpful and harmful environmental aspects of interaction of plants and the environment.

Language Cards/Key Signs
some plants
helpful
harmful
some environmental factors
temperature
air
rainfall

Identification Cards
(variety of plant names/types as seen on outdoor excursions)

****

EVALUATION: Lesson Cluster 1B-2 Plants Cause Changes
Page T-86/S-36 Plants Change Environments (20-30 min.)

PURPOSE: To evaluate student performance in relation to:
1. Drawing plants in a picture to best improve an environment.
2. Developing a plan to prevent erosion.
3. Identifying/drawing examples of erosion.

ADVANCE PREPARATION: Delete the last 4 sentences of student text page 86.

TEACHING SUGGESTIONS:

1. Read through the evaluation and explain what the questions are asking for.

2. Allow students the time to complete the evaluation.

3. Correct each paper individually and mark and record the correct response.

4. Use the activity defined in the last 4 sentences of student text page 36 for an additional activity if students show problems.

****

Level 4 Unit 1 Environments

Part B Populations Change Environments, Lesson Cluster 1B-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-92	Introduction	You and Air	35-45 min.
T-94	Development	People Change Air	15-25 min.
T-95	Development	How People Change Land	15-25 min.
T-96	Development	Changing the Water Factor	15-25 min.
T-98	Development	Changing Other Populations	25-35 min.
T-100	Development	Noise in the Neighborhood	15-25 min.
T-102	Evaluation	What Do You Think?	20-30 min.

B. MATERIALS: See list on page T-89.

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction in a Population is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1B-3 People Cause Changes
Page T-92/S-37 You and Air (35-45 min.)

PURPOSE: To introduce the concepts related to environmental changes caused when people interact with factors in the environment.

ADVANCE PREPARATION: Materials - Two of the following for each student:

- plastic bags
- rubber bands or tape
- straws
- paper clips
- vials of BTB solution
- black crayons
- newspapers

Language Cards/Key Signs
air
BTB
to investigate
to change
indicator

Identification Cards
plastic bag
vial
BTB

TEACHING SUGGESTIONS:

1. Tell the students you will be investigating air and people. Allow each student to collect a set of apparatus identifying everything. Caution the children on BTB.

2. Allow each student to construct their bags according to the picture in student text page 37. Teacher may paraphrase the instructions on page 37. First and/or write directions on board.

3. Have the students collect room air in one bag, and blow into the other.

4. Empty the contents of each bag (squeeze through the straw) into the BTB, one at a time.

5. Discuss the change in the BTB, clean up, and wash up. Review term indicator.

6. Read and discuss You and Air or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should describe evidence of change in the air factor caused by exhaling in terms of color change of BTB.

****

DEVELOPMENT: Lesson Cluster 1B-3 People Cause Changes
Page T-94/S-39 People Change Air (15-25 min.)

PURPOSE: To further investigate air changes caused by people.

ADVANCE PREPARATION: Materials - tape and 5 strips of cardboard for each child

Language Cards/Key Signs
pollution
smoke
air

Identification Cards

TEACHING SUGGESTIONS:

1. Explain that the students will be investigating effects of people and machines on the environment factor of air.

2. Have students make loops of tape and attack them (sticky side out) to the strips of cardboard.

3. Hang one strip outside, in front of an exhaust pipe of a car while engine is running, in front of the mouth of a person exhaling smoke, in the smoke of a candle, over a fire, and in the room.

4. After one week (for the two hanging ones) compare all strips. Discuss the differences in terms of degree of harm.

5. Read and discuss page 39 in text or teacher may paraphrase.

DESIRED LEARNING OUTCOME: The students should describe evidence of harmful changes in air factors caused by people.

****

DEVELOPMENT: Lesson Cluster 1B-3 People Cause Changes
Page T-95/S-40 How People Change Land (15-25 min.)

PURPOSE: To extend what the students have learned about the changes in the air factor caused by people to the changes they cause in land.

ADVANCE PREPARATION: Materials - a variety of pictures of the surrounding community through its history
- poster board
- markers

Language Cards/Key Signs
some trash
some litter
some garbage

Identification Cards

TEACHING SUGGESTIONS:

1. Have the students observe the pictures of their community. Ask them to sequence the pictures from oldest to newest.
2. Discuss the changes made by man on the community.
3. Take one or two class periods to walk around the community observing trash, pavement, buildings, construction, etc.
4. Return to the class and discuss the changes and changing they observed. Discuss the changes in terms of "helpful" and "harmful" to humans and other animals. Have students make a poster with helpful and harmful change listed on it.
5. Read and discuss page 40 in text or teacher may paraphrase.

DESIRED LEARNING OUTCOME: The students should be able to identify changes and whether they are helpful or harmful to humans and other animals.

****

DEVELOPMENT: Lesson Cluster 1B-3 People Cause Changes
Page T-96/S-41 Changing the Water Factor (15-25 min.)

PURPOSE: To investigate changes caused by people on the environmental factor of water.

PREREQUISITE: Field trips to the river, water treatment plants, and factories discharging waste material.

ADVANCE PREPARATION: Materials - paper and pencils

1. Fulfill the prerequisites for all children.

Language Cards/Key Signs
pollution
clean
dirty

Identification Cards

TEACHING SUGGESTIONS:

1. Begin lesson by asking students how important they think the water factor in their environment is.
2. Explain to students they will have a race. Distribute paper and pencils to all students. Explain that each person will have 5 minutes to list on his paper all of the different ways plants and animals depend on (need) water. After 5 minutes stop the race. The person with the most ways is the winner. Discuss all student responses. Stress that without water, plants and animals cannot live.
3. Have students look at the pictures on page 41. Discuss each picture through teacher paraphrasing of the questions on page 41.
4. Have students name helpful and harmful changes in water through picture discussion.
5. Read first paragraph on page 41 or teacher may paraphrase.

DESIRED LEARNING OUTCOME: The students should be able to identify helpful and harmful changes in water from the pictures in the text.

****

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DEVELOPMENT: Lesson Cluster 1B-3 People Cause Changes
Page T-98/S-42 Changing Other Populations (25-35 min.)

PURPOSE: To extend the concepts of environmental change to an introduction of the concepts surrounding endangered species.

Language Cards/Key Signs
endangered species

Identification Cards

ADVANCE PREPARATION: Materials
- movies
- books
- filmstrips
- polar bears
- sea otters
- bald eagles
- yellow lady's slippers
- shooting stars (plants)
- redwood trees
- brochures and information about endangered species of the home community

Optional: Past Weekly Reader articles on endangered Aniamsl.

TEACHING SUGGESTIONS:

1. Introduce and discuss the term "endangered" species/population." Have the children write to national and international organizations to obtain information on endangered species.

2. Discuss the films, filmstrips and books.

3. Have the students read the returned literature in conjunction with the text, page 42-43. Discuss the questions and their answers.

DESIRED LEARNING OUTCOME: The children should be able to name several endangered species (animal and plant) and site reasons why each population is endangered.

****

DEVELOPMENT: Lesson Cluster 1B-3 People Cause Changes
Page T-100/S-44 Noise in the Neighborhood (15-25 min.)

PURPOSE: To introduce the terms "pollution" in regards to excessive noise levels in the environment, caused by people.

PREREQUISITE: Auditory training in environmental noise.

Language Cards/Key Signs
pollution

Identification Cards

ADVANCE PREPARATION:

Take field trips around the community, and point out instances of loud noises.

TEACHING SUGGESTIONS:

1. Have the students look at the picture on page 44. Have them tell you all the different 'noises' that are happening in the picture. List three under 'Noise Pollution' on the board.

2. Define pollution as something harmful added to the environment. Explain that pollution happens in 3 different places - air, water, and land.

3. Refer back to list on board. Have students classify as to air, water or land pollution.

4. Have the students read the text page 44 or teacher paraphrase after their field trip.

5. Have students discuss questions on page 44 through teacher paraphrasing. Also discuss noises discovered on field trip. Classify as to whether they happened on air, land or water.

6. As an additional activity have the student find from a magazine and cut out 1 picture showing noise pollution on land, 1 in water and 1 in the air.

DESIRED LEARNING OUTCOME: The students should be able to identify objects and instances of noise pollution in their community.

****

EVALUATION: Lesson Cluster 1B-3 People Cause Changes
Page T-102/S-46 What Do You Think? (20-30 min.)

PURPOSE: To evaluate student performance by listing reasons for decisions made as to helpful and harmful changes people make in the environment.

ADVANCE PREPARATION:

Add a statement to student text page 46 to describe environmental changes made in the picture on student text page 25.

TEACHING SUGGESTIONS:

1. Explain to the students how they are to respond to the evaluation. If students need more help, sign each phrase to them and ask Does this help or harm the environment?

2. Allow time for students to complete reading and answering the questions.

3. Discuss score and record answers with each individual student.

****

Level 4 Unit 1 Environments

Part C Interaction in an Environment, Lesson Cluster 1C-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Cluster	Teaching Time Suggested
T-120	Introduction	Cause a Sudden Change	20-30 min.
T-121	Development	Disasters	60 min.
T-124	Evaluation	Recognizing Sudden Changes	20-30 min.

NOTE: Disasters, T-121; Water and Sudden Changes, T-122; and Sudden Changes Around the World, T-123 have been combined into one lesson.

B. MATERIALS: Add the following to the list on T-117:
- films, filmstrips, and pictures about disasters. (i.e. floods, earthquakes, tornadoes, etc.)

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interactions in a Population, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1C-2 Sudden Changes
Page T-120/S-55 Cause a Sudden Change (20-30 min.)

PURPOSE: To introduce the children to the effects sudden changes have on populations.

ADVANCE PREPARATION: Determine areas of the local environment that have rocks, boards, or logs the students will be able to move and look under.

Language Cards/Key Signs
change
sudden
moist

Identification Cards

TEACHING SUGGESTIONS:

1. Explain to the students that they are going to cause sudden changes in small environments. Tell them they will have to observe quickly and closely the effects of that sudden change.

2. Have students look under rocks, old boards, etc. and observe what happens with animals underneath. Caution the children as they look under things, especially if your area has poisonous animals.

3. Return to the classroom and discuss the results. Stress that sudden changes in the environment cause sudden changes in populations. Have students name the sudden changes they saw occur when they looked under rocks, logs, etc.

DESIRED LEARNING OUTCOME: The students should cause sudden changes in soil environments and be able to describe the results in terms of their effect on animal populations.

****

DEVELOPMENT: Lesson Cluster 1C-2 Sudden Changes
Page T-121/S-56 Disasters (60 min.)

PURPOSE: To extend student knowledge to the sudden changes of natural disasters.

ADVANCE PREPARATION: Materials - films/filmstrips and books about earthquakes, fires, tornadoes, volcanoes, hurricanes, blizzards, lightning, dust storms, floods, etc.

Language Cards/Key Signs
disasters
sudden change
blizzard
flood
volcano
earthquake
fire
predict
banks

Identification Cards

TEACHING SUGGESTIONS:

1. Allow the children time to view all the media. Alert them to the danger signals your area has for natural disasters, civil defense, weather bulletins, etc.

2. Have the children draw pictures of the results of disasters.

3. Invite outside special people from fire stations, etc. to speak to the class on safety precautions.

4. Look at the pictures on page 56. Discuss what the students think might have happened in the pictures. Discuss the questions on page 56.

5. Read and discuss "Water and Sudden Changes," T-123 or teacher may paraphrase.

7. Have students name as many disasters as they can and list on the board. Instruct them to pick one and have students write a paragraph on a disaster and what happens to the populations after the disaster happened. (real or imaginary) On the bottom half of the paper students can draw a picture to illustrate their disaster. (Ex. volcano, blizzard, earthquake, flood, fire, lightning, tornado, hurricane.)

DESIRED LEARNING OUTCOME: The students should be able to name two kinds of natural disasters and describe their affects on populations.

****

EVALUATION: Lesson Cluster 1C-2 Sudden Changes
Page T-124/S-54 Recognizing Sudden Changes (20-30 min.)

PURPOSE: To evaluate student perofrmance in ability to identify effects of sudden changes in populations.

TEACHING SUGGESTIONS:

1. Read through the evaluation with the students and describe the necessary responses.

2. Allow students time to work on their own.

3. Grade and record correct answers with the individual student.

****

Level 4 Unit 1 Environment

Part C Environments Change, Lesson Cluster 1C-1

A. CLUSTER OUTLINE

Page	Teaching Stragegies	Lesson Title	Teaching Time Suggested
T-114	Enrichment	A Field or Forest Trip	60-70 min.
T-108	Introduction	From Field to Forest	30-40 min.
T-110	Development	Capes and Beaches	20-30 min.
T-112	Application	The Grand Canyon	20-30 min.
T-115	Evaluation	Recognizing Slow Changes	20-30 min.

B. MATERIALS: Add the following materials to the list on T-105:
- at least one vial or small jar for each child
- films, filmstrips and/or books showing geological changes caused by moving water
- films, filmstrips about canyons especially the Grand Canyon

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interactions in a Population, is appropriate for use in this unit.

ENRICHMENT: Lesson Cluster 1C-1 Very Slow Changes
Page T-114 A Field or Forest Trip (60-70 min.)

PURPOSE: To enable the students to observe local plant succession.

ADVANCE PREPARATION:

Locate an area that displays one or more stages of plant succession. Take a hike through the area first, yourself. It is helpful to carry a field guide to aid in plant identification. Make a note of representative plants to later name for the students. You may wish to solicit the aid of a naturalist to accompany your class on the trip.

TEACHING SUGGESTIONS:

1. Begin lesson by explaining that the students will be learning about slow changes that take more than a lifetime to finish. Have students be thinking about the questions How is a forest made? How long does it take for a forest to change from a field to a forest? Go on hike.

2. Explain to the students that environmental factors such as sunlight, temperature, rainfall, and soil conditions may vary in different parts of the world; therefore, the kinds of plants that represent each stage may vary depending on location. If you live in a region in which vegetation varies greatly from that pictured on pages 48 and 49, you may want to discuss reasons for the differences in great detail.

3. Ask the students if they can think of any local plants that they might encounter on their hike. You may want to write a list of suggested plants on the chalkboard for which the students can look.

4. Explain to the students that when taking the trip, they should look for stages from field to forest and types of plants that represent each stage.

5. Caution the students against needless picking of plants and breaking of branches. You may wish to review how such harmful changes have caused populations to become endangered.

6. Go on the trip. Ask the students to observe the area and look for different stages. Help them to identify representative plant populations in each stage.

7. Have the students, when they have returned to the classroom, discuss what they observed on the trip. As a follow-up you may have the students draw pictures of plants, trees, etc. that they saw on their trip and label them according to stage.

****

INTRODUCTION: Lesson Cluster 1C-1 Very Slow Changes
Page T-108/S-48 From Field to Forest (30-40 min.)

PURPOSE: To introduce the concept of slow change by examining stages of plant life in becoming a forest.

ADVANCE PREPARATION:

Background Information - Succession is a term used to described the sequential stages through which plant populations take the place of other populations until a stable forest is produced. By relating two concepts previously developed in this unit - plants live best where the environment is suited to their needs, and plants change factors in their environment - it is possible to infer reasons for the occurrence of plant succession.

The diagram on page 48 shows the succession leading to a maple forest. Weeds that grow in stage 2 of the succession are best suited to an environment that has a lot of sunlight, little nutrients in the soil, varying temperatures, and a tolerance to very wet or dry soil. Those plants in turn change the factors in their environment by shading the surface thus reducing evaporation, and adding nutrients to the soil by decomposition of their remains. The changed environment is then suitable for other kinds of vegetation that characterizes stage 3: bushes, shrubs, and evergreens. As the new populations grow, their roots and branches expand, crowding and shading the pioneer plants. Moisture is taken from the soil and additional nutrients are added. In stage 4, the evergreens grow tall and shade the new maple seedlings. When the maple trees reach maturity, stage 5, they form a ceiling, blocking out much sun. Only the plants that are able to adapt to the shady environment remain. At this point, in stage 6, a balance is achieved and the populations become stable, unless disturbed by a sudden change in the environment.

The example of plant succession presented on page 48 is only one type of succession, that is, succession resulting in a maple forest. Variances in factors such as sunlight, temperature, rainfall, and soil conditions may cause the types of vegetation to vary. It is advisable to find examples of plant succession with vegetation native to your region. Aquatic succession, which commonly precedes the stages shown on page 48, may be of special interest to students living near ponds or lakes.

TEACHING SUGGESTIONS:

1. Have students look at the picture on pages 48-49. Discuss each stage and the time period involved. Refer back to yesterday's field trip.
2. Have students read and discuss pages 48-49 or teacher may paraphrase. Answer questions concerning the picture.
3. Ask students to think of other examples of slow changes and discuss.

Language Cards/Key Signs

show change
stage
maple forest
environment
forest
ages

Identification Cards

DESIRED LEARNING OUTCOME: The student should be able to describe stages of succession of forests, recognize stages by population, and predict future stages.

* * *

DEVELOPMENT: Lesson Cluster 1C-1 Very Slow Changes
Page T-110/S-50 Capes and Beaches (20-30 min.)

PURPOSE: To extend the concept of slow changes to the formation of capes and beaches.

PREREQUISITES: Experience with a variety of moving bodies of water of different sizes. Preferred experience with an ocean.

ADVANCE PREPARATION: Materials - vials for collecting water
- films
- filmstrips
- books on geological changes caused by moving water

TEACHING SUGGESTIONS:

1. Have the students collect water samples from river, stream, creek, brook, or bayou. Label each. Observe the differences of sediment of each (record the speed of current of each in terms of flast or slow).
2. Have the students read or teacher may paraphrase and answer the questions in "Capes and Beaches".
3. Discuss the readings with the class.

DESIRED LEARNING OUTCOME: The students should be able to describe slow changes in land caused by water.

Language Cards/Key Signs

cape
bay
sediment
movement
fast/slow

Identification Cards

river water
stream water
bay water
ocean water
creek water
cape
lake water
brook water
island
bayou

* * *

APPLICATION: Lesson Cluster 1C-1 Very Slow Changes
Page T-112/S-52 The Grand Canyon (20-30 min.)

PURPOSE: To apply what the students have learned to changes in the Grand Canyon.

PREREQUISITE: Exploration of one or more of the following: rivers, valleys, gullies, ravines, streams, brooks, creeks, canyons.

ADVANCE PREPARATION: Materials - films about canyons (the Grand Canyon), books and filmstrips

Language Cards/Key Signs
plateau
Grand Canyon

Identification Cards

TEACHING SUGGESTIONS:

1. Allow the children to view the films /filmstrips and browse through the books. Allow time for discussion. Make sure the children understand what a canyon is.

2. Read "The Grand Canyon" and discuss the questions and answers. Teacher may paraphrase.

3. Have students explain (orally or written) how the Grand Canyon was formed.

DESIRED LEARNING OUTCOME: The students should be able to describe the formation of the Grand Canyon.

****

EVALUATION: Lesson Cluster 1C-1 Very Slow Changes
Page T-115/S-54 Recognizing Slow Changes (20-30 min.)

PURPOSE: To evaluate student performance in: 1) identifying events that change slowly, and 2) calculating the length of time for change of the town pictured.

PREREQUISITE: Subtraction with 4 digit figures, no re-grouping.

ADVANCE PREPARATION: None.

TEACHING SUGGESTIONS:

1. Explain to the students what is required of each item. Clarify question by paraphrasing each.

2. Allow students time to complete the evaluation.

3. Grade and record each evaluation with the individual student, correcting and recording only correct responses.

****

Level 4 Unit 1 Environments

Part C Interaction In An Environment, Lesson Cluster 1C-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-130	Introduction	Sunrise-Sunset	20-30 min.
T-131	Development	Seasons	20-30 min.
T-133	Application	Jobs and Changes	20-30 min.
T-134	Evaluation	Recognizing Regular Changes	20-30 min.

NOTE: Sunrise-Sunset, T-130; and Seasons, T-131 have been combined into one lesson. High-Tide Low-Tide, T-132 has been eliminated.

B. MATERIALS: Add the following materials to the list on T-127:
- pictures of farmers and migrant workers

FILMSTRIP INFORMATION: Filmstrip Set XIII, Interaction in a Population, appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1C-3 Regular Changes
Page T-130/S-60 and T-131/S-61 Sunrise-Sunset and Seasons (60 min.)

PURPOSE: To introduce the concepts around regular rising and setting of the sun.

PREREQUISITE: Elementary graphing and weather observation.

Language Cards/Key Signs
sunrise
sunset
seasons
winter
summer
spring
fall

Identification Cards

ADVANCE PREPARATION:

1. Set up a calendar/graph to record sunrise and sunset throughout the year (search the daily newspaper/television.)
2. Determine one area of the school year incorporating a variety of plants/animals. Take a picture of the area on the first day of each month (for one year).

TEACHING SUGGESTIONS:

1. Discuss the differences between slow and sudden changes with the students.
2. Define regular changes as something that happens again and again after the same length of time. Have students name some regular changes. (Give a few examples if students are having a hard time starting.)
4. Describe to the children how the prepared graphs will be used. Begin and continue to fill in the data.

5. At the end of the year, discuss the changes occuring over time.

6. Have students read and discuss page 60-61 or teacher may paraphrase. Be sure to discuss the pictures and questions on page 61 concerning season. Stress that changes in seasons cause changes in populations.

DESIRED LEARNING OUTCOME: The students should be able to describe changes in seasons and how those changes cause changes in populations.

* * *

APPLICATION: Lesson Cluster 1C-3 Regular Changes
Page T-133/S-63 Jobs and Changes (20-30 min.)

PURPOSE: To investigate careers affected by regular changes in weather.

ADVANCE PREPARATION:

1. Include the farmer and migrant worker by obtaining pictures before reading "Jobs and Changes".
2. Contact various workers, whose occupations are affected by weather, to come and speak to the class.

Language Cards/Key Signs
career
job
seasonal
evidence
clues

Identification Cards

TEACHING SUGGESTIONS:

1. Allow various speakers to discuss with the children the affects weather has on their occupational regularity.

2. Have the students read and discuss "Jobs and Change."

DESIRED LEARNING OUTCOME: The students should be able to describe a variety of jobs in terms of environmental effects on activities of the job.

* * *

EVALUATION: Lesson Cluster 1C-3 Regular Changes
Page T-134/S-64 Recognizing Regular Changes (20-30 min.)

PURPOSE: To evaluate student ability to list sudden, slow, and regular environmental changes and their effects on people.

ADVANCE PREPARATION:

1. Produce a three columned paper with sudden, slow, and regular changes as headings. Omit picture C from the choices since the lesson on tides was omitted.

2. Explain the evaluation and how the students are to respond.

3. Allow time for the students to complete the evaluation.

4. Grade and record correct responses with the student.

* * *

Level 4 Unit 2 Exploring Matter

Part C Matter and Light, Lesson Cluster 2C-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-216	Introduction	Objects and Light	15-25 min.
T-218	Development	Objects and Shadows	20-30 min.
T-220	Development	What Does a Shadow Show	15-35 min.
T-222	Development	Shapes and Light	15-25 min.
T-223	Development	Looking Through Liquids	20-30 min.
T-224	Development	Making Light Bend	15-25 min.
T-225	Development	Light Changes Directions	15-25 min.
T-226	Application	Light and Shadows	15-25 min.
T-227	Evaluation	Light Through Objects	15-25 min.

NOTE: Lessons Making Light Bend, T-224 and Light Changes Directions, T-225 have been combined into one lesson.

B. MATERIALS: See the Materials list on T-213.

FILMSTRIP INFORMATION: Filmstrip Set II Materials, and X Structural Systems, are appropriate for use in this unit.

INTRODUCTION: 2C-1 Light Through Matter
Page T-216/S-106 Objects and Light (15-25 min.)

PURPOSE: To introduce translucent, transparent, and opaque in relation to light interacting with matter in objects.

ADVANCE PREPARATION: Materials - plastic vial
- white paper
- pencil

Borrow a copy of the third level Teacher's Guide to read through the Teaching Strategy Charts for the lesson clusters in Unit 4 that pertain to light. This will enable you either to review with the students what they have previously learned about light or to introduce some of the concepts relating to the reflection of light that they have not investigated.

Language Cards/Key Signs
translucent
transparent
opaque
properties
matter

Identification Cards

TEACHING SUGGESTIONS:

1. Write the words translucent, transparent, and opaque on the board. Explain to the students they will be learning about these words. Define each in terms of light.

2. Distribute a vial, paper and pencil to students. Have them hold them up to a light and look through them. Ask them the questions on page 106.

3. Have one student pick any of the 3 terms and all on another student to pick an object in the classroom that fits the term. Repeat this procedure until all students have had a turn.

4. Read or paraphrase "Objects and Light" with students. When students have finished have them look at the picture on page 107. Ask them the questions on page 107.

5. Additional Activity - Ask students the following questions:
If an object allows no light to pass through, the object is _________.
Give one example __________.
If an object allows some light to pass through, the object is _________.
Give one example _________.
If an object allows all light to pass through, the object is _________.
Give one example _________.

DESIRED LEARNING OUTCOME: Students should be able to identify transparent, translucent, and opaque objects.

* * *

DEVELOPMENT: 2C-1 Light Through Matter
Page T-218/S-108 Objects and Shadows (20-30 min.)

PURPOSE: To extend the knowledge of transparent, translucent, and opaque objects to the type of shadow cast.

ADVANCE PREPARATION: Materials - prepare a collection of vials or pill bottles like the ones on page 108, for each group
- fill half of the transparent vials with water, to capacity. Leave the other transparent vials empty.

Language Cards/Key Signs
transparent
translucent
shadow
opaque
objects

Identification Cards
vial
paint

If it is difficult to obtain translucent vials, you can make vials translucent by rubbing them with sandpaper.
To make transparent vials opaque either paint the vials black or fill them with ink.
Set up the overhead projector and pull down the screen.

TEACHING SUGGESTIONS:

1. Begin the lesson by making sure that the students understand the term shadow.

2. Allow the children the opportunity to mix paint and water in their vials to varying degrees of opaqueness. Number all vials so that no one vial is the same.

3. Have the students predict the type of shadow each vial will cast. Write predictions on the board.

4. Allow time for the students to test their predictions by placing the vials on the overhead projector. Compare results to predictions.

5. Read the discuss, "Objects and Shadows" or teacher may paraphrase. Have students look at the picture on page 109. Teacher should read or paraphrase questions on page 109 for students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to match transparent, translucent, and opaque vials to the type of shadow cast.

****

DEVELOPMENT: 2C-1 Light Through Matter
Page T-220/S-110 What Does a Shadow Show (15-35 min.)

PURPOSE: To increase student skill in observing and describing properties of shadows.

ADVANCE PREPARATION: Materials - various geometric solids
- overhead projector

Geometric solids can be obtained from Math teacher if none are available in your classroom.

Background Information - Inferences about the size and shape of an object, from evidence in shadows, depend on the relative positions of the object and the source of light. We often take it for granted that we can identify an object from the shadow it casts. It is only when a discrepency occurs that we realize that our judgment has been fooled by one of our senses.

Language Cards/Key Signs
shadow
cast
shadow cast

Identification Cards
(geometric solid names)

TEACHING SUGGESTIONS:

1. Allow the children to experiment with shadow play, and to experiment with shadows cast by the geometric shapes. Make sure students see that one object can cast different shadows and that more than 1 object can cast the same shadow.

2. Read "What Does a Shadow Show?" or teacher may paraphrase. Have the students do the activities on both pages.

3. Additional Activity - Set up the overhead in such a way that the students can not see the object on the overhead but can see the shadow it casts. Place 4-6 geometric shapes on a table in front of the room. Show a shadow and have the students guess from which object (shape) or objects could this shadow have been cast from.

DESIRED LEARNING OUTCOME: Students should be able to identify objects from their shadows and predict the type and size (depending on placement of light) of shadows cast.

****

DEVELOPMENT: 2C-1 Light Through Matter
Page T-222/S-112 Shapes and Light (15-25 min.)

PURPOSE: To investigate transparent objects having curved and flat surfaces.

ADVANCE PREPARATION:

Language Cards/Key Signs
curved
flat
pattern

Identification Cards

For jars with curved surfaces, gather the ones that you saved from Observing Crystals, on page T-204, or ask the students to bring in small relish, mustard, jelly, or peanut butter jars.

For jars with flat surfaces, gather or ask the students to bring in well-washed transparent nail polish remover or flavor extract bottles. Empty salad dressing bottles may be used, but be certain that they are unbeveled and actually flat. At least one brand comes in a bottle with a portion of flat surface under the labels.

Optional - Direction chart

TEACHING SUGGESTIONS:

1. Explain to the students that glass can be flat or curved. Show them an example of each. Then have the students go to the supply table and obtain one of each.
2. Explain to the students that they will be learning about light and how it can interact with transparent objects in different ways.
3. Have a chart of the directions the students are to follow on the board or student read from text. Go through each and have the students perform each direction as you go along.
4. Circulate around the room as the students work making certain they are correctly following the directions.
5. When students are finished the activity, teacher should paraphrase the questions on the bottom of page 112 for students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to describe the effects of curved and flat surfaces on light.

****

DEVELOPMENT: 2C-1 Light Through Objects
Page T-223/S-113 Looking Through Liquid (20-30 min.)

PURPOSE: To extend lessons on curved/flat surfaced transparent objects and light to water/air filled.

PREREQUISITES: Completion of previous lesson.

Language Cards/Key Signs
liquid
enlarge

Identification Cards

ADVANCE PREPARATION: Collect enough vials with caps so that each student will have two. Transparent pill bottles with caps that do not leak when they are filled to capacity and laid flat can be used.

Optional - Direction chart

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they are going to find out more about the interaction of light and transparent objects.

2. Have students go to the supply table and get 2 vials. Explain to them they are to fill 1 vial to the top with water and then return to their seats.

3. Have a chart of the directions the students are to follow on the board or students may read directions from student text. Go through each and have the students perform each direction as you go along.

4. Circulate around the room as the students work making certain they are correctly following the directions.

5. Have students read the first paragraph on page 113. Then teacher should paraphrase. the questions on page 113 for students to resond to.

DESIRED LEARNING OUTCOME: Students should describe that water-filled curved transparent objects enlarge viewed through it.

****

DEVELOPMENT: 2C-1 Light Through Objects
Page T-224/S-114 Making Light Bend (15-25 min.)

PURPOSE: To investigate refraction of light through water.

PREREQUISITES: Experience with an aquarium.

ADVANCE PREPARATION: Materials - pencils

Collect enough vials so that every student will have one. Use transparent pill bottles or small glass jars if you do not have vials. Fill the vials with water, leaving enough room at the top to prevent an overflow when pencils are placed in them.

Language Cards/Key Signs
bent
refraction
refract

Identification Cards
(objects used)

Optional - Direction Chart

Background Information - Refraction, or the bending of light, occurs when light travels at different rates through different kinds of matter. A measure of the rate at which light travels through a particular kind of matter is called the refractive index of that kind of matter. The following are the refractive indices of the three kinds of matter most dealt with in this cluster.

Glass	1.5-1.9
Water	1.33
Air	1.00

The higher the refractive index, the more light is slowed down. Of the three kinds of matter given in the list, light is slowed most in the glass, less in water, and least in air.

Evidence of refraction is best observed where the light travels from one kind of matter to the other because that is where light sharply changes direction.

TEACHING SUGGESTIONS:

1. Distribute the water filled vials and pencils to the students.

2. Have a chart of the directions the students are to follow on the board or students can read directions from student text. Go through each and have the students perform each direction as you go along.

3. When students have finished the activity, write the term refraction on the board. Discuss the definition.

4. Have the students read the first paragraph on page 114. Then teacher should paraphrase the questions at the end of page 114 for the students to respond to.

5. Have students look at the pictures on page 115. Teacher should paraphrase the italicized questions for the students to respond to.

6. Have students read the first paragraph on page 115. Then answer the question at the end of the page.

7. Review definition of refraction. Help students to understand that the refraction, or bending, of light is best observed at the surface of the water. This is because the light changes direction when it goes from air to water, or from water to air. Also refraction occured where light went from air to glass (or plastic) or from glass (or plastic) to air.

DESIRED LEARNING OUTCOME: Students should infer the bending of light on the surface of water.

****

APPLICATION: 2C-1 Light Through Objects
Page T-226/S-116 Light and Shadows (15-25 min.)

PURPOSE: To allow the students an opportunity to apply their knowledge of shadows and refraction to everyday situations.

PREREQUISITES: Trip to the doctor.

ADVANCE PREPARATION: Materials - various examples of x-ray photographs from local hospital or clinic

Language Cards/Key Signs
x-ray
aquarium

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson by reviewing the definition of refraction.

2. Have the students view the pictures on page 116. Teacher should paraphrase the italicized questions for students to respond to.

3. Have students take turns viewing an aquarium from different positions to observe evidence of refraction.

4. Have the students count the fish in the classroom aquarium in the same 3 positions shown on page 116.

5. Ask the students if they have ever had x-rays taken of them. Explain that doctors use x-rays to tell whether a bone is broken.

6. If you have obtained x-rays, tape them to the classroom windows so the students can observe them. Have students find broken vs. whole bones. See if students can guess which bone in a body the x-ray was taken of.

7. Answer questions on the bottom of page 116.

DESIRED LEARNING OUTCOME: Students should be able to identify areas of viewing an aquarium where refraction will not distort the contents, and identify whole, broken, and types of bones from x-rays.

****

EVALUATION: 2C-1 Light Through Objects
Page T-227/S-117 Light Through Objects (15-25 min.)

PURPOSE: To measure student performance in 1) matching objects to transparent, translucent, opaque, 2) identifying refraction, and 3) drawing/predicting shadows by objects.

TEACHING SUGGESTIONS:

1. Read through the evaluation with the children, describing the responses sought. If necessary, teacher should paraphrase each question, allowing time for the student to respond between questions.

2. Allow time for each student to complete the evaluation.

3. Grade and record correct responses with the individual student.

****

Level 4 Unit 2 Exploring Matter

Part C Looking Through Lenses, Lesson Cluster 2C-2

A. CLUSTER OUTLINE

Page	Teaching Stragegies	Lesson Title	Teaching Time Suggested
T-234	Introduction	Exploring With Lenses	20-30 min.
T=236	Development	Bringing Light Together	15-25 min.
T-238	Development	Focus a Vial	15-25 min.
T-240	Development	Making Objects Look Bigger	25-35 min.
T-242	Application	Images	20-30 min.
T-244	Evaluation	All About Lenses	10-20 min.

B. MATERIALS: Materials List on page T-230.

FILMSTRIP INFORMATION: Filmstrip Set II, Materials and X, Structural Systems, are appropriate for use in this unit.

INTRODUCTION: 2C-2 Looking Through Lenses
Page T-234/S-118 Exploring With Lenses (20-30 min.)

PURPOSE: To introduce the term lens and the concepts related to the magnifying properties of lenses.

ADVANCE PREPARATION:

Language Cards/Key Signs
lens
curved
viewed

Identification Cards

Obtain or have the students bring in newspapers and pieces of cardboard and plastic wrap.
Cut the newspaper, cardboard, and plastic wrap into pieces of the specified sizes.
Cover each piece of cardboard with a piece of newspaper. Include the picture of a person's face in each newspaper piece so that the students observe the tiny dots.
Tape the newspaper to the back of the cardboard. Then cover the newspaper with the plastic wrap and tape it to the back of the cardboard.
Cut each of the straws in half and fill the containers with water.
Gather the magnifiers and put them with all of the other materials.

Optional - Direction chart

TEACHING SUGGESTIONS:

1. Have all materials needed for the lesson on the supply table. Have the term 'lens' and the directions for the activity written on the board or student may read direction from student text.

2. Begin lesson by asking students if they know what a 'lens' is. Explain that they are curved transparent objects. Point out several lenses in the room (magnifying glasses, lens in filmstrip projector or movie projector, contact lens etc.) Explain that they will be learning more about lenses.

3. Have students obtain all materials necessary for activity. Following the directions from the board have them cut their picture from newspaper, cover the cardboard, securing it with tape and plastic wrap.

4. Have the student do the lesson on pages 118 and 119. (Through reading on their own or teacher paraphrased directions on the board.)

5. Explain to the students that a lens is curved so that light passing from the air to that object will refract or bend making the objects viewed through the lens seem larger.

6. Have students read the first 2 paragraphs on page 119 and then teacher should paraphrase questions at the end of page 119 for students to respond to.

7. When students have finished, ask them what a lens is, what it does and to name several examples of a lens.

DESIRED LEARNING OUTCOME: Students should make liquid and gelatin lenses of varying sizes and shapes and describe by comparing the effects on objects viewed through them.

****

DEVELOPMENT: 2C-2 Looking Through Lenses
Page T-236/S-119 Bringing Light Together (15-25 min.)

PURPOSE: To allow students the opportunity to experiment with magnifying glasses.

PREREQUISITES: Ability to measure by centimeters.

ADVANCE PREPARATION:

Cut pieces of white construction paper or other stiff paper to size, if file cards are not available.
Collect the magnifiers and metric rulers. Plug in the filmstrip projector, or a lamp without a shade, in a corner of the room ready to turn on. If you are using a flashlight instead, put it in a corner of the room ready to turn on.
Draw the shades so that the room is as dark as possible when the lights are turned off. The lesson will not go well unless the room is dark and the light source bright.

Language Cards/Key Signs
focal point
light
safety
fire
measure
centimeter
angle
focus
distance
focal length
Identification Cards
magnifying glass

TEACHING SUGGESTIONS:

1. On a sunny day, take the students outside armed with magnifying glasses. Circulate and discuss observations with the children.

2. Stress safety when they discover that magnifying glasses can start fires/burn things.

3. Return to the classroom. Distribute materials to the students. Write the term 'focus, focal point, and focal length' on the board.

4. Explain that when lesn brings all the light together they focus light. Demonstrate with a filmstrip projector by focusing a frame of a filmstrip.

5. Have students practice focusing light. Turn on the projector lamp or flashlight, turn off all room lights. Using magnifying glass and card, have students take turns focusing light. Help when necessary.

6. Turn on lights and discuss focal point. Explain the place where the lens focuses light into the clearest and brightest possible spot is called the focal point. Turn off lights and have all students find the focal point on their cards. Circulate around the room making sure the students are doing it correctly.

7. Turn on lights. Have the students measure with their cm rulers the distance from the focal point to their lens. Write down how many cm it is on a small piece of paper. Turn off lights circulate around the room providng help as it is needed. Be sure to tell students to measure from the center of the focal point to the center of the lens.

8. Turn on lights. Explain to the students what they have just done was to find the focal length. Focal length is the distance from the focal point to the lens. Ask each student what the focal length of their lens is?

9. Distribute different lens. Have students find the focal point and focal length.

10. Have students read page 120 or teacher may paraphrase and then answer the questions.

DESIRED LEARNING OUTCOME: Students should be able to find the focal point of a lens and mark its length.

****

DEVELOPMENT: 2C-2 Looking Through Lenses
Page T-238/S-121 Focus a Vial (15-25 min.)

PURPOSE: To extend the concept of focal points by utilizing vials.

ADVANCE PREPARATION: Optional - Direction Chart

Gather the file cards or pieces of white paper and the rulers.

Fill the vials or pill bottles with water to capacity. Plug in the filmstrip projector or lamp in a corner of the room all ready to turn on. If you are using a flashlight, instead, put it in a corner of the room ready to turn on.

Draw the shades so that the room will be as dark as possible when lights are turned off. The lesson will not go well unless the room is dark and the light source is bright.

Language Cards/Key Signs
focal point
focus
arrow
vial
focal length

Identification Cards
vial
paper

TEACHING SUGGESTIONS:

1. Begin the lesson by telling students that they are going to focus light through water filled, transparent vials. Because of the shape of the vial, they will find the focal line of the vial instead of its focal point.

2. Have directions on making cards and what the students are to do on the board or students can read from student text. Go over the directions with them.

3. Distribute the materials. Turn on the projector or flashlight, turn off the room lights and then have students begin.

4. Circulate around the room providing help as needed. Make sure the students point the arrows on their cards directly toward the bright light.

5. Record the focal lengths on the chalkboard when the students have completed their measurements.

6. Record beside each focal lengths on the chalkboard "large" or "small", if vials of different sizes have been used.

7. Have the students then determine whether large or small vials have long or short focal lengths.

8. Collect materials. Review terms focus, focal length, and focal point.

DESIRED LEARNING OUTCOME: Students should be able to focus a vial and measure its focal length, and compare lenses and focusing.

****

DEVELOPMENT: 2C-2 Looking Through Lenses
Page T-240S-122 Making Objects Look Bigger (25-35 min.)

PURPOSE: To further examine magnification by formal methods.

PREREQUISITES: Ability to multiply.

ADVANCE PREPARATION: Materials - lined paper
- rulers
- pencils
- index cards

Language Cards/Key Signs
magnify
magnification
power of magnification
magnifying glass
times

Identification Cards

Make sufficient copies of the Magnification Mask in the appendix, so that each student will have one. Have students help you cut out the masks and each of the small squares on the masks. The masks will work with lenses that have a magnification of 2x, 3x, 4x, and 5x. The magnification of many lenses is marked somewhere on them.

Plug in the projector or lamp in a corner of the room ready to turn on. If you are using a flashlight, instead put it in a corner ready to turn on.

Draw the shades so the room will be as dark as possible when the lights are turned off. The lesson will not go well unless the room is dark and the light source is bright.

Optional - Direction Chart

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students read the first paragraph on page 122 to find out what a magnifier is.

2. Explain to the students that they must first make a paper and a card to use like the one in the picture on page 122.

3. Distribute lined paper and a card. Have students follow the directions on the board to make their paper and card or students can read from student text. Encourage students to use the pictures on page 122 for help.

4. Next pass out copies of the Magnification Mask in the appendix. Have students cut out the squares. Provide help as needed. When finished, ask students to put aside for later use.

5. Have students read the directions on the top of 123 and look at top picture or teacher may paraphrase. Distribute hand lens. Have students tell you what they are going to do. When everyone understands, begin the activity.

6. Turn on the projector lamp or flashlight, turn off the room lights. Have students view their drawn square on the index card through magnifiers (Do not use Magnification Masks yet). Discuss what happens to the square.

7. Turn on lights. Have student look at bottom picture on page 123 and read the directions that go with that picture or teacher may paraphrase. Have students tell you what they are going to do. When everyone understand, turn off lights and begin the activity.

8. At the end of the lesson, have students respond to the questions at the bottom of page 123.

DESIRED LEARNING OUTCOME: Students should be able to focus objects in a magnifier and determine power of magnification of objects.

****

APPLICATION: 2C-2 Looking Through Lenses
Page T-242/S-124 Images (20-30 min.)

PURPOSE: To relate a focusing of lenses to the human eye.

ADVANCE PREPARATION: Materials - an anatomical chart and model of the eye
- magnifying glasses
- paper
- a sunny day

Optional - Direction Chart

Language Cards/Key Signs
image
spot
picture

Identification Cards
retina
optic nerve
iris
lens
pupil
cornea

TEACHING SUGGESTIONS:

1. Begin the lesson by reminding the students of the lesson in which they focused a bright spot of light on a file card through a lens. Tell the students that today they are going to focus pictures through a lens.

2. Distribute the materials. Draw all the shades but one and have the students begin the activity. Students should either read the directions on page 124 or follow a direction chart prepared by teacher ahead of time.

3. Encourage the students to experiment with the focusing of images on their papers, both near to and far from the light source.

4. When all students have successfully focused an image on the paper, ask them what they saw on their paper. Explain that this picture they saw on their paper is called an image.

5. Write the word image on the board. Have students read first paragraph on page 124 to find a definition of image. Now ask the italicized questions on page 124. If students are unable to answer have them repeat the activity.

6. Have students read page 125 or teacher may paraphrase. Go over the different parts of an eye. Use model if possible. Label all parts with identification cards.

7. Illustrate on the board how the lens of an eye works. Compare the lens of eye to magnifying glass.

8. Students should respond to the question on the bottom of page 125.

DESIRED LEARNING OUTCOME: Students should be able to focus images with a magnifier, and compare its structure of function with that of the eye.
****

EVALUATION: 2C- 2 Looking Through Lenses
Page T-244/S-126 All About Lenses (10-20 min.)

PURPOSE: To evaluate student performance in: 1) listing properties of magnifier, 2) focusing, 3) predicting focusing by drawing, and 4) judging power of magnification.

TEACHING SUGGESTIONS:

1. Read through the evaluation describing responses students should make. If necessary teacher should paraphrase each question, allowing time for the student to respond between questions.

2. Allow time for students to complete the evaluation.

3. Grade and record correct responses with each student.
****

Level 4 Unit 2 Exploring Matter

Part A Properties of Matter, Lesson Cluster 2A-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-144	Introduction	Getting Ready	20-30 min.
T-145	Introduction	Placing Objects by Properties	20-40 min.
T-146	Introduction	Describing the Missing Object	15-25 min.
T-148	Development	Many Kinds of Matter	25-35 min.
T-150	Application	Useful Metals	20-30 min.
T-152	Evaluation	Recognizing Properties	15-25 min.

B. MATERIALS: See Materials List on page T-141.

FILMSTRIP INFORMATION: Filmstrip Set II, Materials and X, Structural Systems, are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2A-1 Kinds of Matter
Page T-144/S-67 Getting Ready (20-30 min.)

PURPOSE: To allow student practice with metric linear measurement in the preparation of specified shapes.

PREREQUISITES: Knowledge of shapes and experience with centimeter sticks.

ADVANCE PREPARATION: Materials - Have the following for each child:
- scissors
- metric ruler
- paper clip
- pencil
- construction paper, assorted colors

Language Cards/Key Signs
measure
size
centimeter
square
triangle
rectangle
circle

Identification Cards

TEACHING SUGGESTIONS:

1. Have the students turn to their text page 67. Explain that they will be making the shapes they see on the page (four of each shape, each a different color). Review the terms square, rectangle and triangle.
2. Allow students time to read and discuss the page. Go over the directions for making the paper objects with them.
3. Allow students time to make the shapes. Walk around the room helping where necessary.

DESIRED LEARNING OUTCOME: Students should be able to perform metric linear measurement and make paper shapes of specified sizes.

****

INTRODUCTION: Lesson Cluster 2A-1 Kinds of Matter
Page T-145/S-68 Placing Objects by Properties (20-40 min.)

PURPOSE: To review the term property and to introduce the term to new students.

PREREQUISITES: Description of objects by properties.

ADVANCE PREPARATION: Materials - paper objects from "Getting Ready"

Language Cards/Key Signs	
shape	identify
property	

TEACHING SUGGESTIONS:

1. Review the term property. Explain to the students that all objects have properties. Color, shape, and size are all properties. Be sure students understand that properties describe objects. (Ex. small, large, red, yellow, square, triangle, etc..)

2. Tell the students they are going to play a game. Have the students spread sets of paper objects in front of them and mix up the objects.

3. Place an object (paper shape) in view of the students. Explain to the students that the first player must put another object beside it. The object must have 2 properties the same as the one already placed and one property different.

4. Practice until all students understand the game. The teacher should go first. Explain that when an object is played, the students must say how it is same and how it is different.

5. Example: Teacher: My object has the same shape and the same color but different size.
   Student: (lays next object down and says) My object has the same size and the same color, but different shape.

6. Have students play the game.

7. When finished have students respond to the questions at the bottom of the page.

DESIRED LEARNING OUTCOME: The students should be able to describe two paper objects having two alike properties and one different in terms of shape, size, and color.

****

INTRODUCTION: Lesson Cluster 2A-1 Kinds of Matter
Page T-146/S-69 Describe the Missing Object (15-25 min.)

PURPOSE: To review the term property.

ADVANCE PREPARATION: Materials -paper objects from "Getting Ready"

Language Cards/Key Signs	
missing	object
property	identify
Identification Cards	
rectangle	square
triangle	

TEACHING SUGGESTIONS:

1. Divide the students into groups of four or five to play the game. Each player in each group should, to the extent possible, have a set of paper objects of a different color.

2. Explain to the students that they are going to play a game based on the properties of the sets of paper objects that they previously made.

3. Have the students turn to page 69 and read the brief introduction to the activity.

4. Review or introduce the term property before going further. Make certain that the students understand that properties are characteristics of objects by having them describe some of the properties of paper objects, such as blue, green, square, large, and small. Encourage the students to use the term when describing objects.

5. Have the students read the directions for the game. Go over the directions, using the picture on text page 69, to be sure that the students understand what they are to do.

6. Have the students play the game.

DESIRED LEARNING OUTCOME: Students should be able to identify missing shapes by the process of elimination, and describe paper objects by their properties.

****

DEVELOPMENT: Lesson Cluster 2A-1 Kinds of Matter
Page T-148/S-70 Many Kinds of Matter (25-35 min.)

PURPOSE: To expand the meaning of the word property to other objects.

ADVANCE PREPARATION: Materials - wallet
- eraser
- plastic scoop
- emery board
- spoon
- watch
- pencil
- other objects can be taken from the room when needed

Language Cards/Key Signs
describe
size
shape
matter
property
object
heavy
light
leather
rubber
metal
plastic
wood
transparent
opaque
translucent
flexible
pliable
colors
shiny
dull

TEACHING SUGGESTIONS:

1. Review the term matter - make sure students understand that matter is what objects are made of. Hold up several objects, one at a time, telling the students for example, "This paper clip is made of matter" or "This pencil is made of matter."

2. Explain that the students will be naming and describing objects (ideal for a language lesson). Allow each student to select an object and to spend some time manipulating it.

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3. Allow children time to write sentences describing an object of their choice, and display the written work next to the object. Introduce some new terms for the students to use in describing kinds of matter: transparent, opaque, translucent, flexible, pliable, shiny, dull etc.

4. Read and discuss "Many Kinds of Matter," or teacher may paraphrase.

Identification Cards
wallet
eraser
plastic scoop
emery board
spoon
watch

(various other objects)

DESIRED LEARNING OUTCOME: Students should be able to name a variety of kinds of matter and describe it in terms of observable properties.

****

APPLICATION: Lesson Cluster 2A-1 Kinds of Matter
Page T-150/S-72 Useful Metals (20-30 min.)

PURPOSE: To extend the student's ability to describe objects to the group of metals, and to illustrate the use of metals in everyday life.

ADVANCE PREPARATION: You may want to collect the objects shown on page 72 or as many other metal objects as possible to circulate among the students. By handling the objects, the students can observe properties of the various metals that cannot be observed in the pictures.

Language Cards/Key Signs
describe
properties
metal
aluminum
copper
gold
silver
zinc
brass
chrome
nickel
pewter
iron

Identification Cards
(names of objects used)

TEACHING SUGGESTIONS:

1. Explain the term metal. Have the students, in turn locate a metal object. Have that student name and describe the object. Assist the student in the use of proper use of property terminology. Teacher may describe a metal first so students know what is expected of them.

2. Continue the activity until all students are describing metal objects, and naming them with little or no assistance from the teacher.

3. Read and discuss "Useful Metals," or teacher may paraphrase. Teacher should paraphrase numbered questions for student to respond to.

DESIRED LEARNING OUTCOME: Students should be able to relate properties to various metals and their uses.

****

EVALUATION: Lesson Cluster 2A-1 Kinds of Matter
Page T-152/S-73 Recognizing Properties (15-25 min.)

PURPOSE: To evaluate student ability to: 1) measure objects in metric linear units; 2) match objects and properties, and 3) name kinds of matter.

ADVANCE PREPARATION: Materials - each student will need:
- paper
- pencil
- text
- metric ruler

TEACHING SUGGESTIONS:

1. Read through the evaluation, describing to the studentsthe type of answers looked for. If necessary, teacher should paraphrase each question allowing time for students to respond between questions.

2. Allow time for students to complete the evaluation.

3. Grade and record correct responses with the individual student.

****

Level 4 Unit 2 Exploring Matter

Part A Properties of Matter, Lesson Cluster 2A-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-158	Introduction	Matter Has Phases	15-25 min.
T-160	Development	Some Mysterious Matter	25-45 min.
T-162	Development	Describing Quicksand	15-25 min.
T-164	Development	Gases	15-25 min.
T-166	Application	Phases of Foods	20-30 min.
T-167	Evaluation	Solids, Liquids, and Gases	20-30 min.

B. MATERIALS: See list on T-155.

FILMSTRIP INFORMATION: Filmstrip Set II, Materials and X, Structural Systems, are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2A-2 Phases of Matter
Page T-158/S-74 Matter Has Phases (15-25 min.)

PURPOSES: To review or introduce the concept of phases of matter.

ADVANCE PREPARATION: Materials - collect examples of (2 each)
- solids, liquids, and gases

Language Cards/Key Signs
phase
phases of matter
matter
solid
liquid
gas

Identification Cards

TEACHING SUGGESTIONS:

1. Review the definition of matter. Explain to the students that you will be discussing phases of matter, introduce the terms phases of matter, solid, liquid and gas either through the students or teacher.
2. Present objects representing the three phases. Allow students time to generate examples of each phase.
3. Read and discuss "Matter Has Phases" or teacher may paraphrase.
4. Walk around the room, pointing to obects. Students must respond as solid, liquid, or gas. As an additional activity, have students make 3 columns on a piece of paper. (solid, liquid, gas) Students can go through the alphabet, find a solid or liquid or gas for A. Then B and so on.

Example:

Solid	Liquid	Gas
Ball	Juice	Air
Car		Fumes
Dirt		
Elephant		etc.
Ice		

~~ABCDEF~~GH~~IJ~~

DESIRED LEARNING OUTCOME: The students should identify solids, liquids, and gases as three phases of matter, and describe the phase of matter of objects in their environment.

****

DEVELOPMENT: Lesson Cluster 2A-2 Phases of Matter
Page T-160/S-75 Some Mysterious Matter (25-45 min.)

PURPOSE: To extend student learning about phases of matter to properties that distinguish solids and liquids.

Language Cards/Key Signs

Identification Cards

ADVANCE PREPARATION: Materials - The following will make enough Language Cards "Umlik" for 15
- 1 large bowl or container for mixing
- 13 drops of cologne, any
- water (178 mL or 6 oz.)
- 10 drops of red, blue or green food coloring
- ½ box of starch
- 1 mixing spoon
- 15 pieces of plastic wrap, 18 cm x 18 cm (7 in. x 7 in.)
- Direction chart on how to make "Umlik" - see Teaching Suggestions

1. Put on display so students can read it.

TEACHING SUGGESTIONS:

1. Allow students to help make Umlik by using the following directions.

Instructions for Making "Umlik"

Begin to make the mixture by adding the food coloring and cologne to the water! Then place the starch in a bowl and slowly add the mixed liquids. You will find that "Umlik" becomes increasingly difficult to mix. This necessitates a folding in of the ingredients.

Cut up the plastic wrap into squares. Because it is difficult to spoon "Umlik" you will only be able to put approximate amounts of it on each square. Just be sure that each student will have enough "Umlik" to observe all of its properties.

2. Collect cologne, food coloring, starch, and water. Mix 13 drops of cologne with 10 drops of food coloring. To that add 178 mL of water, and 1/2 box starch. Place the "umlik" on the wax paper.

3. Caution the children not to eat the Umlik, and demonstrate the correct way to test for odor. Be sure no students are allergic to starch, cologne, or food coloring.

4. Allow students opportunity to play with their Umlik. Store it in wax paper, inside of newspaper.

5. Ask the students the properties of Umlik. List on chalkboard.

6. Read and discuss "Some Mysterious Matter" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should be able to identify some properties of solids and liquids.

****

DEVELOPMENT: Lesson Cluster 2A-1 Phases of Matter
Page T-162/S-77 Describing Quicksand (15-25 min.)

PURPOSE: To extend student learning of phases of matter to the specific example of quicksand.

ADVANCE PREPARATION: Materials - any media dealing with quicksand

Language Cards/Key Signs
safety
danger
panic
properties
quicksand

Identification Cards

Background Information - Quicksand is a mixture of loose sand and water in which heavy objects sink. It is usually found in a mass on the bottom of streams, on sand flats, or near the mouths of large rivers. The underlying layers of these streams and shores are usually of stiff clay or of other impenetrable materials that prevent the drainage of water from currents and tides. As a result, the collected water is forced upward through the sand, separating and lifting its grains. The mixture becomes too unstable to support heavy objects.

Quicksand is dangerous because it looks like ordinary sand, appearing at sight to be solid. Someone caught in deep quicksand should remain calm and should not struggle. The danger of sinking can be lessened by falling flat on the back. It also helps to stretch out the arms at right angles to the body. In this position it is possible to float on top of the quicksand to firm ground nearby and then slowly roll off the quicksand onto the firm ground.

TEACHING SUGGESTIONS:

1. View media on quicksand. Discuss the safety/danger of it, and what to do if one gets caught. Discuss the properties of quicksand and the phase of matter.

2. Read and discuss "Describing Quicksand" or teacher may paraphrase.

3. Develop a list of solids, liquids, and gases in and around the school and home.

DESIRED LEARNING OUTCOME: Students should be able to identify some properties of solids and liquids.

****

DEVELOPMENT: Lesson Cluster 2A-2 Phases of Matter
Page T-164/S-78 Gases (15-25 min.)

PURPOSE: To extend student knowledge of phases of matter to specific properties of gases.

ADVANCE PREPARATION: Materials - Obtain dry ice, perfume/cologne (can also use a rotten egg to introduce sulfur)
- jar

Language Cards/Key Signs
air
oxygen
carbon dioxide

Identification Cards
dry ice
perfume
cologne

TEACHING SUGGESTIONS:

1. Write the words carbon dioxide and oxygen on the board. Explain that the students will be investigating gases and their properties. Introduce the lesson by pouring CO_2 out of a bowl containing dry ice (caution the children not to touch the ice). Have the children describe CO_2.

2. Position the children around the room, unstop a bottle of cologne in one corner, and time how long it takes for all students to smell the cologne. Discuss the change of cologne from a liquid to a gas (evaporation) and the time it took for the gas to travel (dissipate) throughout the room.

3. Have the students look at the 3 gases on page 79. Ask questions about size, shape, and color of the gases.

4. Teacher should paraphrase questions on page 79 for the students to respond to.

5. Help the students to understand that: some gases have color; gases fill all of the space in a closed container; gases lighter than air will escape when container lids are removed.

6. Show the students a covered glass jar and ask them what they think is in the jar. They will probably say "air" or "gas". Ask those students who say "nothing" if something may have entered the jar before the lid was put on.

7. Ask the students to describe the air in the jar and the air around them in terms of shape, size, and color. Help the students to understand that gases can -
   - go anywhere
   - take up all the space around
   - are invisible.

8. Read and discuss "Gases" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should be able to identify some properties of gases and distinguish among gases, solids, and liquids on the basis of their properties.

****

APPLICATION: Lesson Cluster 2A-2 Phases of Matter
Page T-166/S-80 Phases of Foods (20-30 min.)

PURPOSE: To extend the identification of phases of matter to the preparation of food.

ADVANCE PREPARATION: Materials - paper and pencil for each student

TEACHING SUGGESTIONS:

Language Cards/Key Signs
cafeteria
solid
liquid
gas
phase of matter
Identification Cards
(food names)

1. Have the students name foods and classify them under solid, liquid or gas (smell the food).

2. Discuss how foods are used and stored based on their phase of matter.

3. Have student look at the picture on page 80. Name the different kinds of foods.and the phases of matter each are in.

4. Read and discuss "Phases of Foods" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should be able to identify phases in which foods are found and relate these phases to the use and appearance of the food.

****

EVALUATION: Lesson Cluster 2A-2 Phases of Matter
Page T-167/S-81 Solids, Liquids, and Gases (20-30 min.)

PURPOSE: To evaluate student learning in the identification of phases of matter.

TEACHING SUGGESTIONS:

1. Read through the evaluation, describing how the students are to respond. If necessary, teacher should paraphrase each question allowing time for students to respond between questions.

2. Allow each student time to complete the evaluation.

3. Grade and record correct answers with the individual student.

****

Level 4 Unit 2 Exploring Matter

Part A Properties of Matter, Lesson Cluster 2A-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-174	Development	What is Structure?	70 min.
T-178	Application	Functions Your Way	50 min.
T-172	Introduction	Parts of Properties	30 min.
T-179	Evaluation	Structure and Function	20 min.

NOTE: What is Structure? and The Structure of Objects have been combined into one lesson. What is Function? and Function Your Way have been combined into one lesson.

B. MATERIALS: See Materials List on page T-169.

FILMSTRIP INFORMATION: Filmstrip Sets II, Materials and X, Structural Systems, are appropriate for use in this unit.

DEVELOPMENT: Lesson Cluster 2A-3 Arrangement of Matter
Page T-174/S-84 What is Structure? (70 min.)

PURPOSE: To investigate the external and internal structures of objects.

PREREQUISITES: Well developed hand-eye coordination.

ADVANCE PREPARATION: Materials
- several plastic knives
- 1 paring knife, teacher's use
- newspaper
- variety of fruits and vegetables
- knives and newspaper
- orange, pickle, cucumber, carrot, tomato, radish, lemon, onion, beet, potato, apples, strawberry and watermelon are good examples
- paper and pencils

Language Cards/Key Signs
investigate
describe
structure
properties
arrange
external
internal

Identification Cards
inside structure
(heading for bulletin board)

TEACHING SUGGESTIONS:

1. Explain to the students that they will be investigating the structure of fruits and vegetables.

2. Have the students wash the food and their hands and cover their desks with newspaper. Demonstrate the proper use of knives.

3. Have the students observe and feel the outside structure of the fruits and vegetables. Compare and contrast different external structures.

4. Have students look at the pictures on page 84. Explain that they will be observing the internal structure. Illustrate how to cut in both directions. Have students cut their fruits and vegetable obtaining slices from end to end and slices cut across.

5. Allow plenty of time for the students to make drawings of their slices. Suggest that they first draw the shape of the slices and then add the inside structures.

6. Have the students make a bulletin board display about structure. The students drawings of structure can be placed on the bulletin board.

7. Read and discuss "What Is Structure," "The Structure of Objects," and the individual student exploration. Teacher should paraphrase questions for students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to describe and compare external and internal structures of fruits and vegetables in terms of how they are arranged.

****

APPLICATION: Lesson Cluster 2A-3 Arrangement of Matter
Page T-178/S-88 Function Your Way (50 min.)

PURPOSE: To discuss the structure and function of everyday objects and of the various parts of plants.

PREREQUISITES: Completion of lesson cluster and knowledge of plant structure.

ADVANCE PREPARATION: Materials - screwdriver
- glass
- toothpick
- shoe
- straw

TEACHING SUGGESTIONS:

1. Introduce the term function. Be sure that students understand that the function of a part of an object is what the part does or how the part acts because of its structure.

2. Have the students look at the pictures on page 87. Teacher should paraphrase the questions.

3. Discuss functions of the different parts of a plant. Ask students what is the function (or job) of the stem of a plant? (seeds, roots, leaves, and fruit)

Language Cards/Key Signs
function
structure

Identification Cards
fruit names
vegetable names
screwdriver

toothpick
tongue depressor
stem
seed
root
leaves
fruit

4. Have students read the first paragraph on page 87.

5. Hold up a screwdriver and ask students what the function of a screwdriver is. (Pass screwdriver around for students to observe.) Ask students to think of all the different functions a screwdriver could have.

6. Follow above procedure for other items.

7. Have students read page 88 and discuss the questions.

DESIRED LEARNING OUTCOME: The students should be able to identify fruit and vegetables skin, their structure and function, and identify intended functions of various objects used by people, and relate function to structure.

****

INTRODUCTION: Lesson Cluster 2A-3 Arrangement of Matter
Page T-172/S-82 Parts and Properties (30 min.)

PURPOSE: Introduce the concept that the properties of objects are determined by the kind of matter in them and the arrangement of their parts.

PREREQUISITES: Description of objects.

ADVANCE PREPARATION:

TEACHING SUGGESTIONS:

1. Hold up various objects in the classrom and ask the students to describe how the parts of the object are arranged (put). Review definition of structure and function.

Language Cards/Key Signs
arrangement
parts
structure

Identification Cards

2. Have the students look at the pictures on page 82. The teacher should ask the italicized questions for the students to respond to.

3. Next have the students look at the pictures on page 83. The teacher should ask the questions (paraphrasing may be necessary) for the students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to identify some properties that are determined by the arrangement of matter in the object.

****

EVALUATION: Lesson Cluster 2A-3 Arrangement of Matter
Page T-179/S-89 Structure and Function

PURPOSE: To evaluate student performance in 1) naming external and internal structures, 2) matching structure to function, and 3) naming structural properties related to their function.

ADVANCE PREPARATION: Materials - paper
- pencil
- textbook

TEACHING SUGGESTIONS:

1. Read through the evaluation with the students explaining how they are to respond. Be sure students understand that they can use each letter more than once. If necessary teacher should paraphrase each question, allowing time for the students to respond between questions.

2. Allow time for each student to complete the evaluation.

3. Grade and record correct responses with the individual student.

****

Level 4 Unit 2 Exploring Matter

Part B Earth Matter, Lesson Cluster 2B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-188	Development	Making Layers	25-45 min.
T-187	Introduction	What is a Layer?	15-25 min.
T-190	Development	A Kind of Layered Rock	15-25 min.
T-192	Application	Layers In Trees	15-25 min.
T-193	Evaluation	Lots of Layers	20-30 min.

B. MATERIALS: Materials list on page T-183 as well as the following:
- films or filmstrip on sedimentary rocks, rivers, river mouths, delta areas
- pictures of layered items such as beds, sandwiches, lasagna, clothing and rock layers

FILMSTRIP INFORMATION: Filmstrip Sets II, Materials and X, Structural Systems are appropriate for use in this unit.

DEVELOPMENT: Lesson Cluster 2B-1 Looking At Layers
Page T-188/S-92 Making Layers (25-45 min.)

PURPOSE: To allow students the opportunity to make and observe layering.

ADVANCE PREPARATION: Materials - Obtain covered glass jars for each child
- small stones
- garden soil
- find sand
- newspaper

Language Cards/Key Signs
layers
settle
layering
sediment

Identification Cards
stone/pebble
soil
sand
jar
lid

TEACHING SUGGESTIONS:

1. Demonstrate for students how much of each substance they should put in the jars but do not shake the jar. Emphasize that only 1/3 of the jar should be filled with solids.

2. Remind students to put on the tops (lids) of their jars tightly to avoid spills.

3. Have students go to the supply table and fill their jars. Also have students cover their desks with newspaper.

4. Have the students place a layer of each of sand, soil, and pebbles in their jar (the children determine the order). Fill each jar with water and cap it. Have the student draw a "before" picture.

5. Allow the student to vigorously shake their jars and observe the settling/sediments in the jar. Once everything has settled (fine particles may remain floating), have the students draw an "after" picture. Allow the jars to stand overnight. Compare the drawings and the settled jar.

6. Provide time for students to compare their drawings. Be sure students understand the concept of layers.

7. Read and discuss "Making Layers". Teacher should paraphrase.

8. Show filmstrip on "Layered Structures".

DESIRED LEARNING OUTCOME: The students should be able to identify youngest and oldest layers that settle out of the mixture and relate properties of solids to the order in which they settle.

****

INTRODUCTION: 2B-1 Looking At Layers
Page T-187/S-91 What Is a Layer? (15-25 min.)

PURPOSE: To introduce the term layer and concepts related to the layered structure of some matter.

ADVANCE PREPARATION: Materials - pictures of beds, sandwiches, foods (like lasagna), clothes, and rock layers
- magazines
- poster board
- glue
- scissors

Language Cards/Key Signs
layer
properties
piled
lint
collage

Identification Cards

TEACHING SUGGESTIONS:

1. Explain to the children that they will be investigating the structure of layers.

2. Have the children observe the collected pictures and count layers. Discuss the concept of "oldest" and "youngest" layers, and how it can be determined.

3. Make certain that the students understand that a layer is a thickness of matter over or under another thickness.

4. Read and discuss "What Is a Layer?" or teacher may paraphrase.

5. Pass out magazines. Have students find pictures of objects that have layers. When finished introduce the term 'collage'. Have students make a collage of layered structures on poster board.

DESIRED LEARNING OUTCOME: The students should be able to identify layered objects, determine the number of layers, and describe the order in which the layers were formed.

****

DEVELOPMENT: Lesson Cluster 2B-1 Looking at Layers
Page T-190/S-94 A Kind of Layered Rock (15-25 min.)

PURPOSE: To extend what has been learned about the settling out of solid layers from a mixture of solids and water in a jar to the formation of sedimentary rock as it occurs in materials at the mouth of a river.

PREREQUISITES: Experience with dirt in moving bodies of water.

ADVANCE PREPARATION: Materials
- films or filmstrips on sedimentary rocks, rivers, river mouth, delta areas
- samples of shale, limestone, sandstone, conglomerate

Language Cards/Key Signs
delta
river
mouth
sediment
bits
sedimentary
rocks

Identification Cards
sandstone
shale
conglomerate
limestone

TEACHING SUGGESTIONS:

1. Allow students time to view films, read books, and filmstrips on sedimentary rocks, rivers, delta areas, (river mouths).
2. Introduce the lesson by explaining to the students that the layers they saw form in their jars are similar to a way a certain kind of rock forms.
3. Explain what sediment is (solid matter that settles to the bottom of a liquid). Ask students if they have even seen sediment before? (Refer back to jar.)
4. Through the use of illustrations, show the students how sedimentary rock is formed. Be certain students understand that sediment can build up on the bottom of a river or at its mouth. (Define mouth of river as the place where the river meets the ocean.)
5. Circulate some samples of sedimentary rock and magnifiers for students to observe.
6. Read and discuss pages 94-95. Teacher should paraphrase questions for students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to describe sedimentary rock and how it forms.

* * *

APPLICATION: Lesson Cluster 2B-1 Looking at Layers
Page T-192/S-96 Layers in Trees (15-25 min.)

PURPOSE: To apply student knowledge of layers and growth rings in trees.

PREREQUISITES: Field trips to arboretums or nature trails showing cross sections of trees.

ADVANCE PREPARATION: Materials - Obtain cross sectional slices of a variety of trees, and films on the growth of trees.

Language Cards/Key Signs
rings
growth

Identification Cards
(names of trees)
(names of fruits and vegetables with rings/layers)

TEACHING SUGGESTIONS:

1. Allow students time to view the media and samples of the growth of trees.

2. Have students count growth rings and compare the size of growth rings amongst samples. Have students decide which are the youngest and oldest rings.

3. Read and discuss "Layers in Threes." Teacher should paraphrase questions for students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to count growth rings in trees and determine the youngest and oldest rings.

* * *

EVALUATION: Lesson Cluster 2B-1 Looking at Layers
Page T-193/S-97 Lots of Layers (20-30 min.)

PURPOSE: To evaluate student performance in (1) drawing layered objects, (2) identifying river flow and location of sediment and build-up, and (3) listing properties of sedimentary rock.

TEACHING SUGGESTIONS:

1. Read through the evaluation with the children, describing the responses they are expected to make. If necessary teacher should paraphrase each question, allowing time for the students to respond between questions.

2. Allow each child time to finish the evaluation.

3. Grade and record correct responses with each individual child.

* * *

Level 4 Unit 2 Exploring Matter

Part B Earth Matter, Lesson Cluster 2B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-202	Development	Rock Particles	15-25 min.
T-200	Introduction	Kinds of Rocks	20-30 min.
T-206	Development	Crystals	15-25 min.
T-204	Development	Observing Crystals	30-45 min.
T-208	Application	Ores	15-25 min.
T-210	Evaluation	Rocks and Minerals	15-25 min.

B. MATERIALS: Materials list on T-196 and 197.

FILMSTRIP INFORMATION: Filmstrip Set II, Materials and X, Structural Systems, are appropriate for use in this unit.

DEVELOPMENT: 2B-2 Looking Inside Rocks
Page T-202/S-99 Rock Particles (15-25 min.)

PURPOSE: To investigate the composition of rocks (minerals).

ADVANCE PREPARATION: Materials - white paper
- magnifying glasses

For instructions on how to prepare bags of mineral particles, see Materials List for Cluster B-2.

Place the prepared bags of crushed rock, the white paper, and the toothpicks on a centrally-located table where the students may easily obtain them during class.

If you have not already collected some rock and mineral books, obtain some at this time to aid the students in their investigation of minerals. Find some children's books about minerals. Also look for some books about minerals in the adult section of the library. Some them will have excellent colored photographs of minerals that the students can enjoy and learn from even if the text is above their level.

Language Cards/Key Signs
composition
safety
mineral

Identification Cards
sand
mineral names
hammer
safety goggles
plastic logs

Background Information - Minerals the basic content of rocks. A single rock may contain a variety of minerals. A mineral possesses a unique set of properties such as hardness and color. Distinctive properties of minerals also include luster, or the way in which a mineral reflects light, specific gravity, or the mineral's weight in relation to the weight of the same volume of water, and cleavage, or the way in which a mineral usually splits along planes producing smooth surfaces.

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing with the students that parts of an object and how they are arranged is called structure of an object. Remind the students that, before, they observed the outside and inside structure of fruits and vegetables. Also remind the students that in earlier lessons they observed the outside (external) structure of rocks.

2. Explain that in this lesson, they will observe the inside (internal) structure of rocks.

3. Tell the students they will be investigating minerals that compose rocks. Stress that particles of minerals are found in rocks. The particles always show the same properties.

4. Allow the students time to observe their rock samples. Have them separate out the minerals into piles. Discuss the properties of the piles.

5. Have the student bag individual piles into a class bag of similar minerals (have them try to search books to identify the minerals).

6. Read and discuss "Rock Particles." Teacher should paraphrase questions for students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to distinguish among several minerals by comparing their observable properties.

****

INTRODUCTION: 2B-2 Looking Inside Rocks
Page T-200/S-98 Kinds of Rocks (20-30 min.)

PURPOSE: To review formation of sedimentary rocks and to introduce igneous and metamorphic rocks.

ADVANCE PREPARATION:

Background Information - Rocks are divided into three major groups based on how the rocks formed: sedimentary, igneous, and metamorphic.

Sedimentary rocks form from layers of sediment that are cemented under great pressure.

Shale, an example of a smooth, finely-textured sedimentary rock, is primarily composed of consolidated clay layers. Conglomerate, another sedimentary rock, can be recognized by its rounded pebbles embedded in the fine sandy matter. Limestone, whose layers are rarely visible in samples, is usually formed in a sea environment. It forms either from the remains of small animals that contained calcite or from dissolved calcite that has come out of the water.

Igneous rocks form from magma, or the hot liquid mineral matter that is inside the earth. Igneous rocks may be divided into two groups based on where the magma from which they formed solidified.

Igneous rocks formed from magma that slowly cooled and hardened beneath the earth's surface are called intrusive igneous rocks. They may be identified by their observable mineral particles and large crystals. Granite is the most common intrusive igneous rock.

300

Extrusive igneous rocks are those formed from magma that quickly cooled after reaching the earth's surface through volcanoes or narrow cracks. These rocks have microscopic crystals. Rhyolite is an example of an extrusive igneous rock. It has the same composition as granite, but differs from granite in the size of its mineral particles.

Metamorphic rocks were originally igneous or sedimentary rocks buried deep in the earth. Due to tremendous pressure and heat within the earth, the rocks changed.

Materials - a variety of rock samples and media related to rocks

TEACHING SUGGESTIONS:

1. Allow the students ample time to browse through the rock media and samples. Discuss the observations of the children.
2. Allow the students time to group the rock samples into three sets. Discuss the grouping of the rocks and properties of each group.
3. Go outside and have the children collect a variety of rocks. Visit a rock shop, quarry, cement company.
4. Have students read pages 98-99 or teacher may paraphrase.

DESIRED LEARNING OUTCOME: The students should be able to distinguish the three major categories of rock on the basis of how it was formed.

Language Cards/Key Signs
formation
deposited pressure
sedimentary
igneous
metamorphic
properties

Identification Cards
limestone
granite
slate
shist
quartz
shiny
striped
rough
smooth

****

DEVELOPMENT: 2B-2 Looking Inside Rocks
Page T-204/S-101 Observing Crystals (30-45 min.)

PURPOSE: To extend investigation of minerals to the exploration of crystals.

ADVANCE PREPARATION: Buy a small box of borax in the laundry detergent section of the supermarket. There are at least two nationally advertised brands available. Read the label on the box to make sure that you purchase pure borax rather than a detergent that contains borax. Also read the precautions on the box.

Put one-half cup of borax into each of the plastic sandwich bags and close each bag with a twist-tie. Then wash your hands. Gather small jars from among those that you saved from Making Layers or ask students to bring in the jars from home. Small relish, mustard, jelly, or peanut butter jars with a 226 to 330 gram capacity are of sufficient size for the quantities of borax and hot water that are given. If larger jars are used, more of each materials will be required for crystal formation.

Cut 12 cm lengths of string. If class time is limited, you can tie the pencils and paper clips to the strings as shown in the illustration on page 101, rather than have the students do it.

Collect the newspapers, paper clips, hand lenses, and plastic spoons.

Set up the hot plate in a safe place away from the students where you can heat the water. Fill the kettle with the designated amount of water and place it nearby.

Clear some spaces around the classroom where the filled jars may be placed at the end of the lesson. Choose locations that are out of the general traffic patterns, but that are easily accessible to the students when they observe their jars.

To prepare for the demonstration part of the lesson, set up the projector. Put one spoonful of salol in the dish on the stage of the projector.

If you have not already collected some rock and mineral books, obtain some at this time to aid the students in their investigation of crystals. Find some children's books about crystals. Also, look for some books about crystals in the adult section of the library. Some of them will have excellent colored photographs of crystals that the students can enjoy and learn from even if the text is above their level.

Materials - Direction chart, newspaper, pencils, string, spoons, bags of borax, hand lens, paper

SAFETY ALERTS:

1. Caution the students who bring in glass jars to wrap them in paper toweling or cloth before bringing them to school. Also, advise them not to run while they are carrying the jars.
2. Provide a special place in the room where the jars may be kept until the students use them. Do not permit the students to keep glass jars in their desks where the jars may get broken and cause cuts.
3. Read the caution or warning on the box of borax. Do not permit the students to touch the borax with their hands. Allow them only to use a spoon to transfer borax to the jars. Warn the students of the danger of putting their hands near their eyes or mouths or on their faces during the activity. Provide time for them to wash their hands as soon as they have completed the lesson. Be sure that you wash your hands, too.
4. Warn the students against touching the hot jars while they are adding borax to the water.
5. Do not permit the students to pour hot water into jars or to carry hot jars to the places where the jars will be left to cool. You should be the only one to do either of these things, using pot holders.

Background Information - Some minerals are in the form of crystals. Crystal faces, or surfaces, form where they have room to grow, such as in a rock cavity. Crystal faces that occur naturally should not be confused with the cleavage faces, or flat reflective surfaces, that result when minerals split.

Crystals can usually be identified by their shapes. They may be classified into six basic systems.

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining that they will be making crystals. Name all apparatus and caution the children on the handling of borax. Make sure that students understand that minerals are sometimes in the form of crystals and that they are aware of the properties of all crystals.

Language Cards/Key Signs
safety
solution
saturated
crystals

2. Go over the safety factors concerning Making of Crystals.

3. Place direction chart for students to view. Go over directions with students. Make certain all students understand clearly what they are to do.

4. Hold up a plastic bag of borax and a spoon and caution the students to use a spoon when they take borax out of the bag. Demonstrate the procedure.

5. Remind students to keep hands away from their faces and not to touch the jars of hot water.

6. Fill the jars with 3/4 cup of hot water and deliver to children.

Identification Cards
borax
paper clip
pencil
string
hand lens/magnifying glass
plastic spooon
pot holders
jar
newspaper
water heater
salol

7. Have the students set up their apparatus (the string and clip go in the water last). Allow them to stir in the borax. Students should use picture on page 101 as a guide and follow direction chart for making crystals.

8. When borax begins to settle to the bottom (solution is saturated), put the paper clip in and allow the solution to sit undisturbed. Crystals will form as the water cools, allow children to observe and draw their crystal formation.

9. Caution students about disturbing the jars when they observe with hand lenses.

10. Show how salol crystals melt and reform when cooled.

11. Read and discuss "Observing Crystals". Have students list several properties of their crystal formations on the board. Discuss.

DESIRED LEARNING OUTCOME: Students should be able to describe the formation and properties of borax and salol crystals.

****

DEVELOPMENT: 2B-2 Looking Inside Rocks
Page T-206/S-102 Crystals (15-25 min.)

PURPOSE: To extend the exploration of crystals to minerals that are in the form of crystals.

PREREQUISITES: Experience with rock shapes.

ADVANCE PREPARATION: Materials
- Fulfill the prerequisite for all students.
- media about crystals, including actual samples of a variety of crystals
- black construction paper
- hand lenses

Language Cards/Key Signs
symmetrical
surfaces
crystal clumps

Identification Cards

TEACHING SUGGESTIONS:

1. Allow students ample time to view the media and interact with the samples. Black construction paper and hand lenses will best allow visibility of salt crystals. Discuss crystals with the children. Stress that crystals have smooth, flat surfaces and straight edges.

2. Read and discuss "Crystals". Teacher should papraphrase questions for students to respond to.

3. Retain crystals for the building of a collection.

DESIRED LEARNING OUTCOME: Students should be able to describe crystals by comparing color, texture, flatness, symmetry, and straight edges.

****

APPLICATION: 2B-2 Looking Inside Rocks
Page T-208/S-103 Ores (15-25 min.)

PURPOSE: To introduce and expand to minerals containing large amounts of metal ores.

PREREQUISITES: Experience with mines and metals.

ADVANCE PREPARATION: Materials - obtain samples of ores, and media on mining, processing and use of metals

TEACHING SUGGESTIONS:

1. Allow students ample time to interact with the media and ore samples. Discuss question and observation.

2. Read and discuss "Ores" or teacher may paraphrase. Stress that metals are found in some minerals, that they are mined deep in the earth or near the earth's surface.

3. Tour the school and identify metals and the ores they came from.

DESIRED LEARNING OUTCOME: Students should be able to identify metals and the ores they came from, as well as to describe the mining and processing of some ores into useful objects.

Language Cards/Key Signs
metal
mineral
ore
mines
pits

Identification Cards
copper
gold
iron
mercury
uranium
nickel
platinum
silver
zinc
aluminum
lead

****

EVALUATION: 2B-2 Looking Inside Rocks
Page T-210/S-104 Rocks and Minerals (15-25 min.)

PURPOSE: To evaluate student performance in (1) matching rocks and minerals to their properties, and (2) list properties of rocks, minerals, ores, and crystals.

TEACHING SUGGESTIONS:

1. Read through the evaluation and describe the type of responses required. If necessary teacher should paraphrase each question, allowing time for the students to respond between questions.

2. Allow each student time to complete the evaluation.

3. Grade and record correct responses with each individual student.

****

Level 4 Unit 3 Patterns

Part A Recognizing Patterns, Lesson Cluster 3A-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-260	Enrichment	Rhythm Patterns	20-35 min.
T-259	Development	Patterns of Motion	15-25 min.
T-257	Development	Making Patterns	20-30 min.
T-262	Application	People Use Patterns	15-25 min.
T-258	Development	Symmetrical Patterns	15-25 min.
T-256	Introduction	A Look at Patterns	20-30 min.
T-263	Evaluation	Recognizing Patterns	30-45 min.

NOTE: Enrichment lesson is optional.

B. MATERIALS: See Materials List on page T-253.

FILMSTRIP INFORMATION: Filmstrip Sets X, Structural Systems and XI, Motion and Change, are appropriate for use in this unit.

ENRICHMENT: Lesson Cluster 3A-1 What is a Pattern? Optional
Page T-260 Rhythm Patterns (20-30 min.)

PURPOSE: To expand the students study of patterns to the rhythm patterns of music.

PREREQUISITES: Enough usable hearing to discriminate between rhythmic patterns.

ADVANCE PREPARATION: Materials -

1. Obtain rhythm instruments and a metronome.
2. Obtain rock music and a record player (headsets for all the children will help.) Select records with an easily detected rhythm in the chorus or refrain if you plan to use recorded music for this lesson. Use, if possible, popular songs with which the students are familiar. If not possible, try to get a recording of Ravel's "Bolero."

Language Cards/Key Signs
music
pattern
beat
rhythm
instrument
notes

Identification Cards
instrument

blocks
cymbals
tambourine
metronome

TEACHING SUGGESTIONS:

1. Introduce the musical instruments by name. Allow children the choice of instrument.

2. Explain the musical staff and how to recognize and count beats. The teacher or the metronome can serve as the pace setter.

3. Practice following the beat in various patterns of rhythm.

4. Listen to rock records and allow the children time to discover the beat and follow it with their instruments.

DESIRED LEARNING OUTCOME: Students should be able to recognize and reproduce rhythmic patterns.

****

DEVELOPMENT: 3A-1 What Is a Pattern?
Page T-259/S-133 Patterns of Motion (20-30 min.)

PURPOSE: To introduce students to patterns of motion and the record tracks they leave.

PREREQUISITES: Observation of footprints of a variety of animals.

ADVANCE PREPARATION: None.

Language Cards/Key Signs
track
footprint
record

Identification Cards
highway tire tracks
erosion
windshield wipers
animal tracks
(examples of other findings)

TEACHING SUGGESTIONS:

1. Take a trip around the room, school, and schoolyard looking for records of patterns of motion. Explain that the way objects are put (positioned) in a group makes (forms) a pattern.

2. Return to the classroom and list records and the type of object leaving the record of the pattern of motion.

3. Have students look at the pictures on page 133. Ask students what moving object made each pattern of motion? What happened again and again to made the pattern?

4. Make sure students understand the distinctions between patterns of motion that leave records and patterns of motion that do not leave a record.

5. Have students read page 133. Teacher should paraphrase the 2 last questions on the page.

DESIRED LEARNING OUTCOME: Students should be able to identify and describe patterns of motion and the records they leave.

****

DEVELOPMENT: 3A-1 What Is a Pattern?
Page T-257/S-131 Making Patterns (20-30 min.)

PURPOSE: To allow the children an opportunity to make their own patterns.

PREREQUISITES: Sequencing ability.

ADVANCE PREPARATION: Materials -

1. Obtain 2 tipi shapes, 2 circles, 2 parallelograms, 2 pentagonal shapes per child, (see student text page 131) of varying colors.

Language Cards/Key Signs
arrange shape
pattern
relative
related
size

Identification Cards

TEACHING SUGGESTIONS:

1. Show students your set of shapes. Instruct your students to make a set for themselves. They are to use 2 different colors and cut out 5 shapes. Stress that the shapes can be all the same or all different. They can vary in size. Encourage imagination.

2. Allow time for the children to create patterns. Circulate around the room and help when necessary. Review definition of pattern.

3. Allow for more than one student to work together, combining their shapes into more intricate patterns.

4. Have the children describe their patterns to the rest of the class. As one child describes the pattern, see if the other students can make the pattern from their shapes and his/her description.

5. Read and discuss, "Making Patterns" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should recognize positions of objects are related to forming patterns. They should be able to make and describe patterns.

****

APPLICATION: 3A-1 What Is a Pattern?
Page T-262/S-134 People Use Patterns (15-25 min.)

PURPOSE: To apply student knowledge of patterns of daily life.

ADVANCE PREPARATION: None.

Language Cards/Key Signs
daily
pattern

Identification Cards
types of patterns

TEACHING SUGGESTIONS:

1. Read and discuss "People Use Patterns" or students should look at pictures and while teacher paraphrases questions for students to respond to.

2. Allow the children time to invent/remember patterns they have seen in the home, school, etc. List these on the board.

3. Allow students the choice of patterns to draw and have them draw an example of patterns they have developed.

DESIRED LEARNING OUTCOME: Students should be able to identify patterns in their daily life.

****

DEVELOPMENT: 3A-1 What Is a Pattern?
Page T-258/S-132 Symmetrical Pattern (15-25 min.)

PURPOSE: To enable students to discriminate between patterns that are symmetrical and asymmetrical.

PREREQUISITES: Same and different - concept of ½.

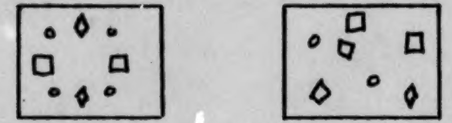
ADVANCE PREPARATION: Materials - construction paper of different colors

Language Cards/Key Signs
symmetry
asymmetrical
patterns
symmetry

Identification Cards
(objects used)
butterfly

TEACHING SUGGESTIONS:

1. Introduce and explain the words symmetrical and asymmetrical. Illustrate on board.
2. Read and discuss "Symmetrical Patterns" or teacher may paraphrase. Have students decide which patterns are symmetrical and which are asymmetrical.
3. Tour the room and school searching for symmetrical patterns.
4. Return to the classroom and list, in two columns, examples of symmetrical and symmetrical patterns.
5. Additional Activity - Using construction paper, have students cut out various shapes and glue onto another piece of construction paper in a symmetrical pattern. Repeat activity for asymmetrical pattern.
   Example:



DESIRED LEARNING OUTCOME: Students should be able to discriminate between symmetrical and asymmetrical patterns.

****

INTRODUCTION: 3A-1 What Is a Pattern?
Page T-256/S-130 A Look at Patterns (20-30 min.)

PURPOSE: To introduce the students to the concept of patterns and some significant properties of patterns.

PREREQUISITES: Sequencing of events, time, objects.

ADVANCE PREPARATION:

Background Information - This lesson is designed to start the students thinking about a pattern as an orderly arrangement of events or objects in time or space. An arrangement need not be symmetrical to form a pattern, it is the positioning of the objects in relation to one another that forms a pattern.

The position of an object can be described only in relation to other objects. The term "relative to" is used to describe an object's position in relation to other objects.

Materials - None.

Language Cards/Key Signs
relative to
(in relation to)
pattern
arrange

Identification Cards
patterns of objects in
the classroom and
school

TEACHING SUGGESTIONS:

1. Explain to the students that they will be looking for patterns around the classroom and school.

2. Take a field trip around the room and school searching for patterns.

3. Come back to the room and list the patterns found on the board. Have each child describe the patterns they saw.

4. Read "A Look at Patterns". Teacher may paraphrase the questions concerning the picture on page 130 for students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to recognize, through experience, how patterns are found.

****

EVALUATION: 3A-1 What Is a Pattern?
Page T-263/S-135 Recognizing Patterns (30-40 min.)

PURPOSE: To evaluate student performance in recognizing patterns in object arrangement and identifying kinds of patterns.

ADVANCE PREPARATION: None.

TEACHING SUGGESTIONS:

1. Read "Recognizing Patterns" and explain the type of responses expected from the children. If necessary, teacher should paraphrase each question, allowing time for the students to respond to.

2. Allow the students time to complete the evaluation.

3. Grade and record correct responses with each student individually.

****

Level 4 Unit 3 Patterns

Part A Recognizing Patterns, Lesson Cluster 3A-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-270	Development	Flip Book Patterns	35-45 min.
T-268	Introduction	Looking for Story Clues	35-45 min.
T-269	Development	Tracks and Facts	20-30 min.
T-271	Application	Pattern Stories Everywhere	20-35 min.
T-272	Evaluation	Stories and Patterns	30-40 min.

B. MATERIALS: See Materials List on page T-265.

FILMSTRIP INFORMATION: Filmstrip Sets X, Structural Systems, and XI, Motion and Change, are appropriate for use in this unit.

DEVELOPMENT: 3A-2 Patterns Tell Stories
Page T-270/S-138 Flip Book Patterns (35-45 min.)

PURPOSE: To extend the students learning of patterns to gathering pattern clues from a series of pictures.

ADVANCE PREPARATION: Materials
- duplicate page T-479, one for every student and teacher
- develop a demonstration model of the flip book
- several staplers, scissors
- pencils and crayons

Language Cards/Key Signs
pattern
picture
series
sequence
flip book

Identification Cards
film
reel
frame

TEACHING SUGGESTIONS:

1. Distribute the flip book pictures. Demonstrate the teacher model by allowing the students to flip through.

2. Have students examine the reel of film, frame by frame to determine sequencing.

3. Ask the students for examples of objects that move and make patterns: animals, people, ships, insects, etc. Then pass out lesson materials.

4. Circulate around the room providing help when necessary. Remind the students that their art work is less important than showing an object in motion.

5. Allow the students time to put together their flip books and draw pictures on them. Exchange flip books and discuss each one.

6. Allow the students time to devise other flip books.

7. Read the discuss "Flip Book Patterns" or teacher may paraphrase.

8. Teacher should ask the numbered questions for students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to recognize pattern clues and demonstrate how they reveal a story.

****

INTRODUCTION: 3A-2 Patterns Tell Stories
Page T-268/S-136 Looking for Story Clues (35-45 min.)

PURPOSE: To introduce students to observing and describing pattern clues and events they evidence.

PREREQUISITES: Observing tracks.

ADVANCE PREPARATION:

Background Information - A clue is a bit of evidence, or information, that helps piece together a story. In this lesson, the patterns are the clues to an event or story. Students may be familiar with the concept of clues as evidence and of clue gathering as detective work, and you may want to refer to this lesson as a form of detective work. The point to stress in this lesson and in the ones that follow is the usefulness of pattern recognition.

Materials - paper and pencil for each student

Language Cards/Key Signs
clue
events

Identification Cards

TEACHING SUGGESTIONS:

1. Have the students study the picture on page 136 of the student text. Ask students what they think happened in the picture. Encourage students to use their imagination to invent what happened in the picture. Allow time for each student to tell his story. Then read the italicized story.

2. Have students draw their own pictures.

3. Have the students write in original language descriptions of their pictures, under the picture. The teacher may re-write into English under the original language.

4. Discuss the student responses, reinforcing the children for creative thinking.

5. Read and discuss "Looking for Story Clues." Teacher may paraphrase questions for students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to recognize, draw, and describe events as interpreted from pattern clues.

****

DEVELOPMENT: 3A-2 Patterns Tell Stories
Page T-269/S-137 Tracks and Facts (20-30 min.)

PURPOSE: To extend student learning about pattern clues. To enhance student observational skills.

ADVANCE PREPARATION:

Background Information - Inferring is the process of making a judgment on what happened based on collected evidence. In the previous lesson, students were inferring events from pattern clues. In this lesson the students will not only make inferences, they will also discover that in some cases not enough evidence is provided to make valid inferences.

Materials - None.

Language Cards/Key Signs
infer
evidence
observe

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the class that some patterns provide enough evidence in a single picture to tell a story, but that sometimes you need many patterns to infer an event. Review if necessary, terms such as infer, evidence, and event.
2. Read and discuss the pictures in "Tracks and Facts." Allow the students time to infer events from the evidence they see. Teacher should ask the questions (paraphrase if necessary) for students to respond to.
3. Discuss causes of events in the pictures distinguishing between what they can and cannot infer from the evidence.
4. Allow students time to read "Tracks and Facts" or teacher may paraphrase.
5. Have the students pick any 1 of the 3 pictures and identify in writing the story they see in that picture.

DESIRED LEARNING OUTCOME: Students should be able to relate pattern clues to evidence of events, judging the amount of evidence required to make accurate inferences.

****

APPLICATION: 3A-2 Patterns Tell Stories
Page T-271/S-139 Pattern Stories Everywhere (20-35 min.)

PURPOSE: To apply what students have learned about pattern clues and patterns to everyday life.

ADVANCE PREPARATION: Materials - none.

Language Cards/Key Signs
evidence
inference
clue
pattern

Identification Cards

TEACHING SUGGESTIONS:

1. Tour the room, school, and schoolyard looking for patterns and pattern clues. Discuss their findings in terms of clues, evidence, and inferences.

2. Read and discuss "Pattern Stories Everywhere." Have students respond to questions through picture observation (page 139).

DESIRED LEARNING OUTCOME: Students should be able to identify and describe patterns and relate clues to actual events.

****

EVALUATION: 3A-2 Patterns Tell Stories
Page T-272/S-140 Stories and Patterns (30-40 min.)

PURPOSE: To evaluate student performance in inferring a story from pattern clues and deducing patterns from a story.

TEACHING SUGGESTIONS:

1. Read through "Stories and Patterns" describing what responses are being called for. If necessary, teacher should paraphrase each question allowing time for students to respond between each question.
2. Allow the students time to complete the evaluation.
3. Grade and record correct responses with each individual student.

****

Level 4 Unit 3 Patterns

Part A Recognizing Patterns, Lesson Cluster 3A-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-278	Introduction	Counting on Patterns	45-55 min.
T-280	Development	Bouncing Ball Patterns	35-45 min.
T-282	Application	Predictions About the Environment	20-30 min.
T-284	Enrichment	Predictions About the Moon	20-30 min.
T-285	Evaluation	Predicting From Patterns	20-30 min.

NOTE: The application and enrichment lessons have been combined.

B. MATERIALS: See Materials List on page T-275.

FILMSTRIP INFORMATION: Filmstrip Sets X, Structural Systems and XI, Motion and Change, are appropriate for use in this unit.

INTRODUCTION: 3A-3 Patterns and Predictions
Page T-278/S-142 Counting on Patterns (45-55 min.)

PURPOSE: To introduce the process of prediction by having students interpret patterns of shadows.

ADVANCE PREPARATION:

Background Information - In the last cluster, students made inferences on the basis of pattern clues they observed. Because they have learned to interpret the clues provided by patterns, they can now begin to rely on the information that a pattern gives. On this basis, students can start to make predictions about patterns they know. In this lesson, the students use shadow patterns to make predictions.

You may want to tell the students about some traditional uses of patterns for prediction making. One such method is a sundial. Another is that in very old houses marks are sometimes found cut into the window sills and numbered with the hours of the day. Explain that this shows that sun shadows are predictable enough to tell time.

Materials - transparent tape
- Direction Chart - (optional)
- unlined paper and pencil for each student
- butcher paper

Language Cards/Key Signs
predict
record
safety

window frame
casts

Identification Cards
apparatus
pencil
paper

Locate surface areas near classroom windows where the window frames case shadows. If the classroom does not receive sufficient sunshine, use shadow-casting objects such as poles, trees, or parallel bars in the school yard.

Remember that this lesson has three fifteen-minute intervals between steps. Plan to fill those intervals with other activities such as discussion of experiences with shadows.

TEACHING SUGGESTIONS:

1. Review how shadows are cast; using windowframe and shaded surface (or a shadow cast by an object outside) to illustrate the concept. Explain to students they will be observing sun shadow patterns and using evidence that they collect to predict shadow movement.

2. Read and follow the directions in "Counting on Patterns" or students can read directions from direction chart. Have students mark on the paper every 15 minutes.

3. After 3 markings (45 min.) ask student which way the shadow moved? (right or left) Then have the students predict where the next mark will be after 15 more minutes.

4. Teacher should paraphrase questions on page 143 for students to respond to after they make predictions on the actual shadow movement.

5. Addition Activity - Construct a sundial - Have students compare the pattern they made with the one on the sundial.

DESIRED LEARNING OUTCOME: Students should be able to predict shadow movement by interpreting sun shadow patterns.

****

DEVELOPMENT: 3A-3 Patterns and Predictions
Page T-280/S-144 Bouncing Ball Patterns (35-45 min.)

PURPOSE: To extend student learning about pattern-based predictions.

PREREQUISITES: Measurement by centimeters; ability to record data.

ADVANCE PREPARATION: Materials - a meter stick
- basketball
- baseball
- tennis ball
- pingpong ball
- stop watch
- large sheet of butcher paper

Duplicate the graph in student text 144 on the board. Duplicate the graph a second time substituting "sec" for "cm" under the three "try's." Pass duplicates to the class for prediction.

Optional - Direction Chart

Language Cards/Key Signs
record
predict
observe
bounce

Identification Cards
meter stick
basketball
pingpong ball
baseball
tennis ball

TEACHING SUGGESTIONS:

1. Explain to the students they will be testing patterns of ball behavior and predicting based on their observation.

2. Have students read page 144-145 or go over the directions on the direction chart. Make sure students understand what they are to do.

3. Explain that all measurements will be made by sighting past the top of the ball to the meter stick when it is dropped and when it bounces up again. Circulate around the room providing help when necessary.

4. Test all four balls at 30 cm. Have the students predict prior to testing on 50, 70, 90 cm. Compare the predictions and the results. Emphasize that they will have to observe quickly and carefully to measure the height the ball was bounced.

5. Using the second graph, time the various balls until they come to rest from being dropped at 30 cm. Have the students predict time from 50, 70, and 90 cm. Discuss the predictions and results.

6. Place the butcher paper next to the wall. Mark a target on the wall. Roll each ball at varying angles to the wall. Plot their paths on the paper. Have the students predict the path and compare the results.

7. Read and discuss "Bouncing Ball Predictions." Teacher may paraphrase questions for students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to collect data and make predictions on the basis of gathered information.

****

APPLICATION: 3A-3 Patterns and Predictions
Page T-282-284 Predictions About the Environment and Predictions About the Moon (60 min.)

PURPOSE: To apply data gathering and prediction making based on patterns to the environment.

PREREQUISITES: Ability to record and graph data.

ADVANCE PREPARATION: Materials - daily newspapers

Record in lesson plans a once a month revisit to this lesson.

TEACHING SUGGESTIONS:

1. Begin having the students record sunrise, sunset, phases of the moon and temperature daily.

Language Cards/Key Signs
moon
season
sunrise
sunset
phase
record

Identification Cards
graph

316

2. Develop and make the following graphs:

	ordinate	abscissa
sunrise	4AM-8AM	month/day
sunset	4PM-8PM	month/day
temperature	0-100	month/day

have the students graph the information daily. Discuss any changes on the calendar moon phases and the graphs.

3. Once a month re-read and discuss "Predictions About the Environment."

DESIRED LEARNING OUTCOME: Students should be able to make predictions about the moon and seasonal changes based on changes based on gathered data.

****

EVALUATION: 3A-3 Patterns and Predictions
Page T-285/S-148 Predicting From Patterns (20-30 min.)

PURPOSE: To evaluate student performance, observing, organizing, interpreting data, and making predictions based on data.

TEACHING SUGGESTIONS:

1. Read and discuss the student text in terms of responses desired. If necessary, teacher should paraphrase each question for students to respond to.

2. Allow the students time to complete the evaluation.

3. Grade and record responses with each student.

****

Level 4 Unit 3 Recognizing Patterns

Part B Patterns of Structure, Lesson Cluster 3B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-292	Introduction	Build a Strong Bridge	35-45 min.
T-294	Development	Paper Supports	35-45 min.
T-296	Application	Using Support Patterns	20-30 min.
T-298	Application	Natural Support Patterns	20-30 min.
T-300	Evaluation	Structures That Support	15-25 min.

B. MATERIALS: See Materials List on page T-289.

FILMSTRIP INFORMATION: Filmstrip Sets X, Structural Systems, and XI, Motion and Change, are appropriate for use in this unit.

INTRODUCTION: 3B-1 Patterns of Support
Page T-292/S-150 Building a Strong Bridge (35-45 min.)

PURPOSE: To introduce the concepts around patterns of structural support.

ADVANCE PREPARATION:

Background Information - From the tiniest insect to the larges elephant and from the most simple toy to the most complex bridge, all objects have some sort of structural system that supports them. As students observe structural patterns within a system, they realize that it's not only the specific properties of size, shape, and material but also the arrangement of the materials in particular patterns that give a structural system strength.

Sometimes these structural patterns of support are easily observed; other times the system must be observed carefully to recognize the structural pattern. By building soda straw bridges, the student learns operationally how structural patterns are retated to the design of the structural system.

Materials - media about bridges
- large number of straws, pins and washers
- books to support straw bridges

Language Cards/Key Signs
weak
strong
sag
pattern
structure

Identification Cards

TEACHING SUGGESTIONS:

1. Place two books on each student's desk, far enough apart so one straw does not bridge the gap. Have students read the first two paragraphs on structure and strength. Review the concept that strength of a structure depends on the kind and arrangement of parts.

2. Draw the first bridge on page 150 on chalkboard for easy reference during the lesson. Distribute materials and begin.

3. Circulate around the room providing assistance. Have students stack washers on their bridges. Instruct students to write on paper how many washers their bridge can support before it sags - then falls.

4. Review the concept that the strength of a structure depends on the kind and arrangement of parts. Have students look at pictures on page 151. Allow them to experiment by making more bridges with more support. Provide help when necessary.

5. Allow time for students to view and question the media on bridges.

6. Read and discuss "Building a Strong Bridge."

7. Conclude by asking students to search magazines for pictures of bridges. When finished compare bridges in terms of support.

DESIRED LEARNING OUTCOME: Students should be able to construct bridges and identify support patterns.

****

DEVELOPMENT: 3B-1 Patterns of Support
Page T-294/S-152 Paper Supports (35-45 min.)

PURPOSE: To extend the concept of structural strength to shape strength.

ADVANCE PREPARATION:

Background Information - Shape is an important property of any structure. Students discover the relationship between shape and strength by building objects from half sheets of construction paper. Although the material remains the same, the students find that different shaped objects can support differing amounts of weight without crushing. Generally, circular supports are strongest and the more the object's shape approaches a circle, the stronger it should be. Therefore, a many-sided object is usually stronger than an object with fewer sides. Since fair tests are difficult to conduct, don't be surprised if your students do not obtain these results. These specific results are not necessary to meet the purpose of this lesson.

Materials - construction paper and tape

Collect enough pieces of colored construction paper, 24 cm x 32 cm (9 in. x 12 in.), so that each student will have three half-pieces of different color paper and additional white pieces for further supports. Cut some of the pieces in half length-wise so that the height of the first batch of paper supports will be 12 cm (4½ in.).

Language Cards/Key Signs
shape
cylinder
triangle
circle
square
rectangle

Identification Cards

With suggestions from the students, set limits on the kind of construction they may make. For example, (1) choose a uniform weight and size of the book they will be supporting. (2) The book must rest on the support unaided. (3) Only a half sheet of construction paper and three small pieces of tape can be used. (4) Tape edges cannot overlap.

You may want to construct the three different kinds of supports for the students to examine before beginning the lesson.

- Direction Chart

TEACHING SUGGESTIONS:

1. Explain to the students how shape is important in structures used for support. Have student view pictures on pages 152-153.

2. Paraphrase directions from student text or chart. Go over directions and limits with students. Distribute materials.

3. Allow the students time to experiment with the paper supporting books. Have students record number of books supported by each structure.

4. Question students as to which was strongest and weakest support.

5. Read and discuss the results of "Paper Supports" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should be able to describe the relationship of shape to strength and distinguish between more and less supportive shapes.

****

APPLICATION: 3B-1 Patterns of Support
Page T-296/S-154 Using Support Patterns (20-30 min.)

PURPOSE: To investigate the use of simple supports in everyday life.

ADVANCE PREPARATION: Materials -

Collect illustrations of bridges, buildings, and other objects for students to look at for further discussion. Use pictures the students may have brought in, and if possible, pictures of nearby structures the students can further examine outside of class. The school or municipal library should carry books on building design that might interest students.

- Ask an architect to speak to the class.

Language Cards/Key Signs
geodesic dome
architect
design
support

Identification Cards
(types of buildings used in examples)

TEACHING SUGGESTIONS:

1. If possible, let the architect discuss building design with the children.

2. Introduce the lesson by reviewing the major ideas from the last two lessons. Emphasize the structural arrangements of straw bridges and paper supports that gave the most support.

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3. View the media and discuss it in terms of structural support patterns.

4. Have students look at the pictures on page 154. Teacher should ask the italicized questions on page 154 for students to respond to.

5. Have students read pages 154-155 or teacher may paraphrase. Have students respond to question on page 155.

6. Examine objects in the classroom for their patterns of support and to determine how these support patterns relate to the function of each object.

DESIRED LEARNING OUTCOME: Students should be able to identify and describe simple support patterns in complex structures.

****

APPLICATION: 3B-1 Patterns of Support
Page T-298/S-156 Natural Support Patterns (20-30 min.)

PURPOSE: To apply the concept of support patterns to those found in nature.

PREREQUISITES: Completion of previous lessons.

ADVANCE PREPARATION:

Background Information - In this lesson, the students will be examining the parallels between the support structure in manufactured objects and those in nature. In addition, the students will discover how certain natural structures such as external skeletons, often serve to protect the living organisms from predators and from injury.

A skeleton determines an organism's habits and growth. Emphasize that the structural support patterns, internal and external, of organisms provide clues to their strength and function, just as the structural support patterns of a manufactured object provide clues to its strength and function.

Materials - media on skeletons and plant support systems
- duplicate, or draw on the chalkboard, the illustration shown on page 157. This picture can serve as an effective illustration of the concepts explored in this lesson.

Language Cards/Key Signs
skeleton
rings
external
internal
support

Identification Cards

TEACHING SUGGESTIONS:

1. Review the term skeleton and introduce the terms internal and external.

2. Pass out the pictures duplicated from the teachers text page 157 (dog, ship). Help students to relate the concept of support patterns in manufactured objects to support patterns found in nature.

3. Ask students What support pattern the dog's is similar to? What support pattern is the back similar to?

4. Have students look at pictures on page 156. Teacher should ask the italicized questions for students to respond to.

5. Repeat step 4 for page 157.

6. Have students read page 156, 157 or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should be able to identify and describe simple support systems in nature.

****

EVALUATION: 3B-1 Patterns of Support
Page T-300/S-158 Structures That Support (15-25 min.)

PURPOSE: To evaluate student performance in determining support systems in animate and inanimate objects and identifying properties of strength in support systems.

ADVANCE PREPARATION: Materials - duplicate T-480, one copy for each student

TEACHING SUGGESTIONS:

1. Read through the lesson describing the types of responses the students are to make. If necessary, teacher should paraphrase each question, allowing time for students to respond between each question.

2. Allow students time to complete their evaluation.

3. Grade and record correct responses with each student.

****

Level 4 Unit 3 Recognizing Patterns

Part B Patterns of Structure, Lesson Cluster 3B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-306	Introduction	Find the Balance Point	35-45 min.
T-308	Development	Balancing Different Weights	20-30 min.
T-310	Development	A Balance Beam	35-45 min.
T-312	Development	Balance and Shape	25-35 min.
T-314	Evaluation	Structures That Balance	20-30 min.

B. MATERIALS: See Materials List on page T-303.

FILMSTRIP INFORMATION: Filmstrip Set X, Structural Systems and XI, Motion and Change, are appropriate for use in this cluster.

INTRODUCTION: 3B-2 Patterns of Balance
Page T-306/S-160 Find the Balance Point (35-45 min.)

PURPOSE: To introduce the concept of balance point and predicting balance points.

ADVANCE PREPARATION:

Background Information - In this lesson the students will discover that all objects have a balance point and that there is a relationship between the weight and the balance point of an object. Predictions about the structure of an object can be inferred from the way it balances.

The balance point is the place on every object from which the object can be supported or hung and remain stable. Most of the weight of an object must be at or below the balance point if the object is to remain stable and balanced. The shape of an object and the internal distribution of weight influence its point of balance.

Materials - meter sticks and weights, enough for each student
- Direction Chart
- tape, pencils

Language Cards/Key Signs
balance
balance point

Identification Cards
meter stick
weight

TEACHING SUGGESTIONS:

1. Explain to the students that "balance point" is the place where an object can be most easily supported. Demonstrate.

2. Paraphrase directions from student text (page 160) on direction chart. Place on board. Go over directions with students. Distribute materials.

3. Circulate around the room providing help during the balancing activities. Discuss findings.

4. Follow teaching suggestions number 2 and 3 for page 161. Explain that students will now be working with balance points for an object in which the weight is not evenly put (distributed).

5. Read and discuss the results of "Find the Balance Point" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should be able to predict and determine balance points.

****

DEVELOPMENT: 3B-2 Patterns of Balance
Page T-308/S-162 Balancing Different Weights (20-30 min.)

PURPOSE: To extend the concept of balance point shift depending on weight distribution.

ADVANCE PREPARATION: Materials
- file cards
- tape
- *weights (such as washers or pennies)
- metric rulers
- scissors

*Each student or pair of students will need at least 4 weights.

- Direction Chart

Language Cards/Key Signs
balance
cylinder
balance point

Identification Cards
file card
weight
seesaw

TEACHING SUGGESTIONS:

1. Paraphrase directions from student text (page 162) on direction chart. Place on board. Go over directions with students. Distribute materials.

2. Allow time for students to construct their cylinders. Check to see that students are following directions properly.

3. Circulate around room asking questions concerning balance.

4. Read and discuss "Balancing Different Weights".

5. Additional Activity - If time permits, experiment with different cylindrical widths and heights.

DESIRED LEARNING OUTCOME: Students should be able to determine balance point shifts based on weight use and distribution.

****

DEVELOPMENT: 3B-2 Patterns of Balance
Page T-310/S-164 A Balance Beam (35-45 min.)

PURPOSE: To further investigate the relationship between weight and balance point.

ADVANCE PREPARATION: Materials - paper puncher

1. Duplicate the chart in student text page 165. Obtain file cards, making a model from student text page 164, guide, string and paper clips.

Make copies of Appendix H, page T-481. Collect enough construction paper, string or wire, and straws or sticks for each group of students to make a mobile. Find pictures of simple mobiles students can use as models. All pictures of mobiles should show the mobiles balanced, with the support sticks horizontal.
Optional - Direction Chart

Language Cards/Key Signs
balance
weight
balance point

Identification Cards

TEACHING SUGGESTIONS:

1. Paraphrase directions from student text (pages 164-165) on direction chart or students may read from text. Place on board. Go over direction 2 with students.

2. Demonstrate how to follow chart on page 165 by following the first few chart directions until students understand what they are to do. Distribute materials.

3. Circulate around the room assisting students with problems and posing different problems (use of 2 weights, etc.) to others.

4. When students have finished, discuss their findings.

5. Read and discuss the results in "A Balance Beam" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should demonstrate understanding of the relationship between balance point and weight.

****

DEVELOPMENT: 3B-2 Patterns of Balance
Page T-312/S-166 Balance and Shape (25-35 min.)

PURPOSE: To develop the concept of balance points to apply to shapes.

ADVANCE PREPARATION: Materials - file cards
- pins
- scissors
- Optional Direction Chart

Language Cards/Key Signs
balance
shape
square
rectangle
triangle
circle

Identification Cards

TEACHING SUGGESTIONS:

1. Paraphrase directions from student text (page 166) on a direction chart or students may read directions from text. Place on board. Go over directions with students.

2. Demonstrate the procedure to follow and how to measure from uncut edge of card to the balance point.

3. Distribute materials. Circulate around the room providng help where needed. Make sure students understand the card must be completely horizontal if it is to be balanced.

4. After students have completed the lesson, a histogram of the distances can be drawn on the chalkboard and discussed.

5. Have students read page 166 or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should demonstrate an understanding of balance point shift dependent on shape.

* * *

APPLICATION: 3B-2 Patterns of Balance
Page T-312/S-167 Mobiles (25-35 min.)

PURPOSE: To apply student knowledge of balance points to the construction of mobiles.

ADVANCE PREPARATION: Materials
- straws
- string
- construction paper

TEACHING SUGGESTIONS:

1. Have students look at pictures on page 167. Define balance points. Discuss what patterns of balance are found in the pictured mobiles.

2. Distribute materials. Have students read the text and construct their mobiles. Allow time for students to be creative.

Language Cards/Key Signs
balance points
mobiles decoration

Identification Cards
mobile
string
construction paper

3. Circulate around room providing help where necessary. Make sure the students understand that art is not that important.

4. Discuss the patterns of balance the students used.

5. Read and discuss "Mobiles" with the class or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should be able to construct balanced mobiles.

* * *

EVALUATION: 3B-2 Patterns of Balance
Page T-314/S-168 Structures That Balance (20-30 min.)

PURPOSE To evaluate student performance determining asymmetrical, symmetrical balance points and weight equivalents for balanced systems.

TEACHING SUGGESTIONS:

1. Read the text and describe the student responses desired. If necessary, the teacher should paraphrase each question allowing time for students to respond between each question.

2. Allow students time to complete the evaluation.

3. Grade and record correct responses with each student.

* * *

Level 4 Unit 3 Patterns

Part C Patterns That Repeat, Lesson Cluster 3C-1

A. CLUSTER OUTLINE

Page	Strategies	Lesson Title	Teaching Time Suggested
T-324	Development	Pendulum Cycles	35-45 min.
T-326	Development	Body Cycles	40-50 min.
T-328	Development	Life Cycles	20-30 min.
T-330	Development	School Day Cycles	30-40 min.
T-332	Enrichment	Sound Cycles	20-30 min.
T-332	Enrichment	Exercise Cycles	20-30 min.
T-322	Introduction	What is a Cycle	15-25 min.
T-334	Application	Working With Cycles	25-35 min.
T-336	Evaluation	Recognizing Cycles	20-30 min.

NOTE: Sound Cycles is optional.

B. MATERIALS: See Materials List on page T-319.

FILMSTRIP INFORMATION: Filmstrip Sets X, Structural Systems and XI, Motion and Change, are appropriate for use in this unit.

DEVELOPMENT: 3C-1 All Sorts of Cycles
Page T-324/S-173 Pendulum Cycles (35-45 min.)

PURPOSE: To enable students to predict cycles based on pendulum behavior.

ADVANCE PREPARATION:

Background Information - A pendulum is an object suspended from a fixed point so it can swing freely under the action of gravity. The pendulum is most commonly used to regulate the movement of clockworks and other machinery. By constructing and observing a simple pendulum, the students learn to recognize and predict cycle patterns of motion in objects.

Materials - string
- washers
- rulers, any, to support pendulums
- books, to support pendulums
- wrist or stop watches or clock with second hands
- paper and pencils
- illustrations of simple pendulums

Language Cards/Key Signs
pendulum
arc
cycles
series

Identification Cards
string
weight

TEACHING SUGGESTIONS:

1. Define a pendulum. Have students look at the picture on page 173. Show illustrations of simple pendulums.
2. Distribute materials. Allow students time to set up their pendulums according to the picture on page 173.
3. Allow them time to experiment varying the length of string and height of starting position.
4. Read and follow the directions in the student text. Demonstrate on chalkboard how to average the number of cycles per minutes.
5. Read and discuss "Pendulum Cycles" or teacher may paraphrase.
6. Be sure students understand that a cycle is a series of events that is repeated.

DESIRED LEARNING OUTCOME: Students should be able to predict patterns of motion in pendulum cycles.

* * *

DEVELOPMENT: 3C-1 All Sorts of Cycles
Page T-326/S-174 Body Cycles (40-50 min.)

PURPOSE: To extend the concept of cycles to include natural patterns.

PREREQUISITES: Ability to record data.

ADVANCE PREPARATION:

Background Information - To get an accurate reading of a pulse, place your finers (not your thumb) on the wrist, neck, or under the jaw. The average pulse rate ranges from 64 to 75 beats a minute. Usually a reading is attained by taking the pulse for 30 seconds and multiplying the count by two. Students who have difficulty finding and following their pulse may want to count for one minute rather than for 30 seconds.

Materials - stop watches
- wrist watches or clocks with second hands

Language Cards/Key Signs
pulse
breath(e)
lungs
swell
heart beat
blood
Identification Cards
stop watch

TEACHING SUGGESTIONS:

1. Show the children how to find their pulse. Have students count the number of times per minute their pulse throbs. Explain that it is the heart pumping blood through their body.
2. Count the number of times the children breathe per minute. Discuss and record breathing and pulse under the conditions described in the text.
3. Read and discuss the results of experimentation in "Body Cycles" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should be able to recognize some cycles in nature and predict natural changes.

****

DEVELOPMENT: 3C-1 All Sorts of Cycles
Page T-328/S-176 Life Cycles (20-30 min.)

PURPOSE: To recognize patterns of change in the life cycles of plants and animals.

ADVANCE PREPARATION: Materials - None.

TEACHING SUGGESTIONS:

1. Have students look at pictures on page 176. Place following list on chalkboard. It is best to mix up the order.

   Seeds
   Young Plant
   Larger Plant with Blossoms
   Plant With Green Tomatoes
   Plant With Red Tomatoes

2. Have students match pharases to pictures. Define life cycles.

3. Repeat steps 1 and 2 for picture on page 177. (Chart - egg, larva, pupia, adult butterfly, egg)

4. Read and discuss "Life Cycles" or teacher may paraphrase the questions for students to respond to.

5. Have the students describe the life cycles of the plants or animal of their choice and draw it.

Language Cards/Key Signs
life cycle
growth cycle

Monarch butterfly
stages
blossoms

Identification Cards
(varying plants and animals)

DESIRED LEARNING OUTCOME: Students should be able to describe a variety of life cycles of plants and animals.

****

DEVELOPMENT: 3C-1 All Sorts of Cycles
Page T-330/S-178 School Day Cycles (30-40 min.)

PURPOSE: To extend the cycle concept to patterns of behavior during the day.

PREREQUISITES: Ability to sequence.

ADVANCE PREPARATION: Materials - none.

TEACHING SUGGESTIONS:

1. Have each student describe his/her day. Help the student list the things he/she does.

2. Ask the students to put times to their activities. Discuss the cycle of everyone's activities.

Language Cards/Key Signs
cycle
daily
behavior
activities
events
cyclic
non-cyclic

Identification Cards

3. Read and discuss, "School Day Cycles" or teacher may paraphrase.

4. Have students write a paper entitled "The Cycle of My Day". Ask students to start with getting up in the morning and finishing with getting up the next morning.

5. Have students read their stories to each other. Ask students how their school day cycle is like the cycle of other school students.

DESIRED LEARNING OUTCOME: Students should be able to describe cyclic and non-cyclic events in their school day routine.

****

ENRICHMENT: 3C-1 All Sorts of Cycles
Page T-332 Sound Cycles - Optional (20-30 min.)

PURPOSE: To expand the concept of cycles to music.

ADVANCE PREPARATION: Materials - None.

TEACHING SUGGESTIONS:

1. Teach the children songs such as This Old Man, Row Row Row Your Boat, I am Sleeping, etc.

2. Describe the cyclic pattern of the songs. Combine with a couple of other classes and try singing in rounds.

Language Cards/Key Signs
round
song
cycle

Identification Cards

DESIRED LEARNING OUTCOME: Students should be able to identify patterns in songs by example.

****

ENRICHMENT: 3C-1 All Sorts of Cycles
Page T-332 Exercise Cycles (20-30 min.)

PURPOSE: Reinforce understanding of cycles by identifying cycles in familiar physical exercises.

ADVANCE PREPARATION: Materials - ask the physical education teacher to come to the room with a stop watch

TEACHING SUGGESTIONS;

Language Cards/Key Signs
cycles

Identification Cards
names of exercises

1. Have the students list exercises they perform in gym class. (Examples: toe touches, rope skipping, chin-ups, push ups, etc.)

2. Time students on the number of exercise cycles they can complete in a minute. Have the P.E. teacher as judge.

3. Discuss other cycles with the students. Challenge them to think of other cycles and list them.

DESIRED LEARNING OUTCOME: Students should be able to recognize patterns of movement as cycles and identify cycles involved.

****

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INTRODUCTION: 3C-1 All Sorts of Cycles
Page T-322/S-171 What Is a Cycle? (15-25 min.)

PURPOSE: To introduce the concept of cycle as a repeating pattern.

ADVANCE PREPARATION: Materials - None.

Language Cards/Key Signs
cycle
events

Identification Cards
hour glass

TEACHING SUGGESTIONS:

1. Have students look at pictures on page 171. Discuss the first 2 questions on page 171. Review that a cycle is a series of events that is repeated.
2. Repeat step 1 for the questions on page 172.
3. Have students read pages 171-172 or teacher may paraphrase. Teacher should ask numbered questions for students to respond to.

DESIRED LEARNING OUTCOME: Students should be able to recognize and describe cycles.
****

APPLICATION: 3C-1 All Sorts of Cycles
Page T-334/S-180 Working With Cycles (25-35 min.)

PURPOSE: To apply student knowledge of cycles to occupational cycles.

ADVANCE PREPARATION: Materials - obatain media of factories and automated systems

You may want to collect some illustrations of cycle usage for reference during this lesson. Fun and recognizable pictures could show bicycles, amusement park rides that repeat in a recognizable pattern, and even a child's pinwheel toy.

Language Cards/Key Signs
work
cycle
factory

Identification Cards

TEACHING SUGGESTIONS:

1. Allow students time to view and discuss the media. Ask students to note cycles in meal cycles, sleep and waking cycles and household cycles.
2. Read and discuss "Working With Cycles". Challenge the students to discuss their own work cycles and those of people they know. Teacher may need to paraphrase questions for students to respond to.
3. Discuss cycles of work in the home.

DESIRED LEARNING OUTCOME: Students should be able to identify work schedules as cycles.
****

EVALUATION: 3C-1 All Sorts of Cycles
Page T-336/S-182 Recognizing Cycles (20-30 min.)

PURPOSE: To evaluate student performance in discriminating between cycles and non-cycles, applying properties of cycles to determine patterns of motion, and identifying cycles.

TEACHING SUGGESTIONS:

1. Read through and describe the student responses to the evaluation. If necessary, teacher should paraphrase each question allowing time for students to respond between each question.

2. Allow students time to complete the evaluation.

3. Grade and record correct responses with each student.

****

Level 4 Unit 3 Patterns

Part C Patterns That Repeat, Lesson Cluster 3C-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-342	Introduction	A Change of Phase	35-45 min.
T-344	Development	Water Comes Out of Air	20-30 min.
T-345	Development	Water Goes Into Air See It Yourself	25-35 min.
T-346	Development	Putting the Cycle Together	20-30 min.
T-348	Application	Cycle in a Cycle	25-35 min.
T-350	Evaluation	Make a Cycle	25-35 min.

NOTE: Lessons What Goes Into Air and See It Yourself have been combined.

B. MATERIALS: See Materials List on page T-339.

FILMSTRIP INFORMATION: Filmstrip Sets X, Structural Systems and XI, Motion and Change, are appropriate for use in this unit.

INTRODUCTION: 3C-2 The Water Cycle
Page T-342/S-184 A Change of Phase (35-45 min.)

PURPOSE: To introduce the concept of the cyclic nature of changes in the phases of matter.

ADVANCE PREPARATION: Materials - water heater
- pans (one filled with ice)
- ice

TEACHING SUGGESTIONS:

1. Review matter as what objects are made of. See if they can recall the 3 phases of matter they learned from last year.
2. Allow the children to watch the change of phase from ice to liquid.
3. Boil the liquid and watch the change from liquid to gas. Review the term evaporate.
4. Hold a pan over the steam and have the children observe the change to liquid. Revelw the term condensation. Explain that when matter changes to the phase that it first was, this is a cycle.

Language Cards/Key Signs
phase
liquid
solid
gas
evaporate
boil
condense

Identification Cards
water
pan
heater
ice

5. Read and discuss "A Change of Phase" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should be able to describe changes in the phase of water as cyclic.

****

DEVELOPMENT: 3C-2 The Water Cycle
Page T-344/S-186 Water Comes Out of Air (20-30 min.)

PURPOSE: To extend the concept of the cyclic phase change of water to condensation.

ADVANCE PREPARATION: Materials - ice

TEACHING SUGGESTIONS:

1. Have students observe condensation of water on cold glasses, breathing on cold windows, and dew. Stress that water condenses on cool surfaces. Review definition condensation - a gas changing to liquid.
2. Have students look at the pictures on page 186. Point out that in all the pictures, the surface where water droplets have fromed is colder than the surrounding air.

Language Cards/Key Signs
liquid
solid
gas
condenses
condensation
dew

Identification Cards
ice

3. Read and discuss "Water Comes Out of Air" or teacher may paraphrase.
4. Review the water cycle process discussed in yesterday's lesson. Ask students to name the phase they are observing in this lesson.

DESIRED LEARNING OUTCOME: Students should be able to describe condensation as the change of a gas to liquid.

****

DEVELOPMENT: 3C-2 The Water Cycle
Page T-345-347/S-187 Water Goes Into Air - See It yourself

PURPOSE: To extend the concept of the cyclic change of water to the concept of evaporation.

ADVANCE PREPARATION: Materials - water heater
- pan of water

TEACHING SUGGESTIONS:

1. Have the students wet objects and set them out to dry, in the shade and the sun. Discuss the speed of evaporation. Stress that evaporation occurs more rapidly on warm surfaces. Explain evaporation as a liquid changing to a gas.

Language Cards/Key Signs
evaporate
liquid
solid
gas
dew
steam
humid

Identification Cards
water
boil

2. Observe dew in the morning and lack of dew later in the day.

3. Observe steam rising boiling water.

4. Report to the students the humidity of the air (if it is a factor).

5. Observe the effects, over time, as a specific spot during and after rain.

6. Read and discuss "Water Goes Into Air" as a function of evaporation or teacher may paraphrase.

7. Review the water cycle process discussed in the first cluster lesson. Ask students to name the phase they are observing in this lesson. Make sure students use the terms evaporation, condensation and water cycle.

DESIRED LEARNING OUTCOME: Students should identify evaporation in the water cycle, and define it as liquid changing to a gas.

****

DEVELOPMENT: 3C-2 The Water Cycle
Page T-346/S-188 Putting the Cycle Together (20-30 min.)

PURPOSE: To review the water cycle.

ADVANCE PREPARATION: Materials - none.

TEACHING SUGGESTIONS:

1. Have the students look at picture on page 188. Ask them to explain how water goes into and comes out of the air. If students are having difficulty, illustrate the water cycle on the board.

2. Read and discuss "Putting the Cycle Together" or teacher may paraphrase.

3. Make a Water Cycle bulletin board using pictures of lakes, rivers, etc. If possible use pictures from the local environment.

Language Cards/Key Signs
evaporate
condensation
water cycle

Identification Cards

DESIRED LEARNING OUTCOME: Students should be able to describe the water cycle in terms evaporation and condensation.

****

APPLICATION: 3C-2 The Water Cycle
Page T-348/S-189 Cycle in a Cycle

PURPOSE: To apply the students knowledge of the water cycle to different cycles in that process.

ADVANCE PREPARATION: Materials - films and filmstrips about rain and rivers

Language Cards/Key Signs
cycle
rain

Identification Cards

Background Information - At this point the students are familiar with the basic evaporation and condensation phases of the water cycle. However, not all of the liquid in this process follows that basic order step by step. Rainwater in a city runs down storm drains into sewers that ultimately drain off into large bodies of water. Similarly, rainfalls in a country environment do not necessarily undergo a process of evaporation that leads to a redeposition on that same country area. Country rain can run downhill into streams, or can be soaked through the ground into streams below the surface. That water ultimately drains off into large bodies of water where the evaporation phase of the water cycle begins again.

Evaporation takes place most often from large bodies of water, such as lakes and oceans. This evaporated water is carried as clouds until it is redeposited on various locations. In this way, country rain can go through a cycle that leads to redeposition on a city, just as city rain goes through a process that leads to rainfall in the country.

TEACHING SUGGESTIONS:

1. Allow the students to view and discuss the rain media.

2. Read and discuss "Cycle in a Cycle" or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should be able to describe cycles within the process of rain.

****

EVALUATION: 3C-2 The Water Cycle
Page T-350/S-191 Make a Cycle (25-35 min.)

PURPOSE: To evaluate student performance in drawing and identifying phases of the water cycle.

TEACHING SUGGESTIONS:

1. Read through the directions and describe desired responses.

2. Allow students time to complete the evaluation.

3. Grade and record correct responses with each student. If necessary teacher should paraphrase each question allowing time for students to respond between each question.

****

Level 4 Unit 4 Exploring Energy

Part A What is Energy?, Lesson Cluster 4A-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-360	Introduction	Interacting Systems	20-30 min.
T-362	Development	Systems and Energy	20-30 min.
T-363	Development	Energy Transfer	15-25 min.
T-364	Application	Energy Everywhere	15-25 min.
T-365	Evaluation	Evidence of Energy	20-30 min.

B. MATERIALS: See Materials List on page T-357.

FILMSTRIP INFORMATION: Filmstrip Set XII, Conduction Systems is appropriate for use in this unit.

INTRODUCTION: 4A-1 What is Energy?
Page T-360/S-194 Interacting Systems (20-30 min.)

PURPOSE: To introduce the concept of interaction, evidence of interaction and system.

ADVANCE PREPARATION: Materials
- hammer
- wood
- nail
- paper
- ruler
- pencil
- scissors
- cloth
- thread
- needle

Language Cards/Key Signs
interact
evidence
system
properties

Identification Cards
(each for objects used
in Advance Preparation)

TEACHING SUGGESTIONS:

1. Place all objects on a table in no particular order. Ask students to choose objects that could make a system. Discuss each system and the possible interactions.

2. Have students look at the pictures on page 194. Discuss what evidence of interaction can be seen in each picture.

3. Make sure students understand the meaning of the terms interaction and evidence.

4. Distribute paper to each student. Instruct the students to interaction in some way with the paper. (Be as ambiguous as possible.)

5. Have one student tell how another student interacts with his paper and what evidence of interaction he saw. Evidence may include such interactions as rumpling, tearing, folding, footmarks, or perhaps even an object wrapped inside the paper itself.

6. Continue step 5 until all students have a turn.

7. Have students look at pictures on page 195. Instruct them to find systems. They should list the objects for each system and a name for the system above each list. Students can compare lists and names.

8. Have student read page 194-195 or teacher may paraphrase.

DESIRED LEARNING OUTCOME: Students should start to use the terms interaction, evidence of interaction and system in describing evidence of interaction.

****

DEVELOPMENT: 4A-1 What Is Energy?
Page T-362/S-196 Systems and Energy (20-30 min.)

PURPOSE: Introduce the concept of energy, including energy givers and receivers, and to relate energy to systems of interaction.

ADVANCE PREPARATION: Materials - an object (book, ball, box, etc.)

Language Cards/Key Signs
energy
energy giver
energy receiver

Identification Cards

TEACHING SUGGESTIONS:

1. Begin lesson by pushing an object across the table. Ask students what moved the box? Accept all responses.

2. Have students read the first paragraph on page 196. Make sure that students understand that energy is necessary for interactions to take place in any system.

3. Write the terms energy giver and energy receiver on the chalkboard. Ask the students to infer the meanings of the terms.

4. Have students look at the pictures on page 196. Ask the italicized and numbered questions.

5. Ask each student to think of a system that may be found at school. Ask one student to name their system then call on another student to tell which object in the system is an energy giver and which is the energy receiver. Let the second student then name a system and call on another student to name the energy giver and receiver. Continue until the students can readily identify energy givers and energy receivers.

6. Repeat teaching suggestion #1. Have students name energy giver and energy receiver.

DESIRED LEARNING OUTCOME: Ability to identify the energy givers and receiver in a system.

****

DEVELOPMENT: 4A-1 What Is Energy?
Page T-363/S-197 Energy Transfer (15-25 min.)

PURPOSE: Extend the concept of energy in systems to energy transfer and evidence of energy transfer.

ADVANCE PREPARATION: Materials - small lamp

Language Cards/Key Signs
energy transfer

Identification Cards

TEACHING SUGGESTIONS:

1. Review the terms energy, energy giver, and energy receiver, and evidence.
2. Begin lesson by plugging in a lamp and turning it on. Ask students what is the energy giver and what is the energy receiver.
3. Explain transfer of energy as the traveling of energy through a system from energy giver to energy receiver. When the object changes this is the evidence of energy transfer. Ask students what the evidence of energy transfer is in the lamp.
4. Check students understanding by naming systems in the classroom and having students describe the evidence of energy transfer shown by those systems.
5. Have each student name a system in the classroom or at home and name energy giver, energy receiver and evidence of energy transfer.
6. Have students look at pictures on page 197 and name energy giver, energy receiver, and evidence of energy transfer.
7. Have students read the first paragraph on page 197. Then teacher should ask numbered questions for students to respond to.

DESIRED LEARNING OUTCOME: Ability to identify evidence of energy transfer in specific systems and name the energy givers and energy receivers.

****

APPLICATION: 4A-1 What Is Energy?
Page T-363/S-198 Energy Everywhere (15-25 min.)

PURPOSE: Apply what has been learned about energy transfer to energy transfer in a subway system.

ADVANCE PREPARATION: Materials - scissors
- magazines
- paper
- pencil

Picture cut from magazine showing evidence of transfer.

Language Cards/Key Signs
subway

Identification Cards

TEACHING SUGGESTIONS:

1. Explain to students they are to find 2 or 3 pictures of systems showing evidence of transfer. They are to number the picture and then list energy giver, energy receiver, and evidence of transfer on paper corresponding to number. Distribute materials

and allow time for students to complete the activity.

2. When students have completed, have them share their pictures and responses with other class members. The pictures can then be used as a bulletin board arrangement.

3. Begin a discussion by asking the students if any of them have ridden on a subway train. (Refer to picture on page 198.) Have them relate their various experiences.

4. Have students look at picture on page 198 and ask them for evidence of transfer and to describe the evidence.

5. Have students read the first paragraph on page 198.

6. As an additional activity, pass out paper and have students make two columns on their paper. Label home and classroom (this activity can be set up as a race, the winner being the student with the most responses).

7. Explain to students they are to think of the evidence of transfer in various system in the classroom and at home and write them on their paper. Allow 10 to 15 minutes to answer. When completed, have each student read their lists to each other.

DESIRED LEARNING OUTCOME: Ability to describe energy transfer in a subway system.
****

EVALUATION: 4A-1 What Is Energy?
Page T-365/S-199 Evidence of Energy (20-30 min.)

PURPOSE: To evaluate student performance in identifying objects in a system, the energy giver, the energy receiver and evidence of energy transfer.

TEACHING SUGGESTIONS:

1. Read "Knowing About Energy" and explain the type of responses expected from the children. If necessary, the teacher should paraphrase each question, allowing time between each for students to respond to.

2. Allow the students time to complete the evaluation.

3. Grade and record correct responses with each student individually.
****

NOTE: Clusters 4A-2, 4A-3 and 4A-4 have been omitted since they require normal hearing and are therefore not appropriate for a hearing impaired and deaf population. Activities in the following clusters relate to the same energy concepts.

Level 4 Unit 4 Exploring Energy

Part B Heat Transfer, Lesson Cluster 4B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-406	Introduction	Thermometers	20-30 min.
T-408	Development	Evidence of Heat Transfer	15-25 min.
T-409	Development	Conductors of Heat	90-100 min.
T-412	Application	The Celsius Scale	15-25 min.
T-413	Application	Saving Heat	15-25 min.
T-414	Evaluation	Recognizing Heat Systems	20-30 min.

B. MATERIALS: See Materials List on page T-403.

FILMSTRIP INFORMATION: Filmstrip Set XII, Conductive Systems is appropriate for use in this unit.

INTRODUCTION: 4B-1 Heat Transfer
Page T-406/S-220 Thermometers (20-30 min.)

PURPOSE: To introduce the thermometer as a means of measuring temperature.

ADVANCE PREPARATION: Materials
- a thermometer
- unmarked thermometers
- paper with narrow lines
- file cards
- transparent tape
- pencils

Language Cards/Key Signs
temperature
thermometers
bulb

TEACHING SUGGESTIONS:

1. Hold up a thermometer and ask the students what it is and what it is for. Explain that a thermometer is used to measure temperatures. Temperature is how cold or hot an object is. Be sure students understand the difference between the two terms.

2. Go over the caution with the students, explaining that the thermometers are made of glass and may break. You may have a student demonstrate the proper way to hold a thermometer.

3. Have students read page 220 or teacher may paraphrase. Go over directions with students. Distribute the unmarked thermometers. Ask students how they will know if a spot is hot or cold. Will the red (mercury) go up or down for hot places? Cold places?

4. Have students go about the room finding hot and cold spots. Discuss where warm and cold spots are located.

5. Have students read the directions for the activity on page 221 or teacher may paraphrase. Demonstrate the procedure for numbering the thermometer with the students. Distribute materials.

6. Let the students begin the activity providing help when necessary. They should be allowed to explore fully the area around their desks to collect data.

7. When everyone is finished, have each student name the warmest and coolest spots near them. When comparing temperature readings, discuss variables that affect them. (The placement of the paper on the card, where the thermometer is taped and space between the lines on the cards).

8. Teacher should ask numbered questions for students to respond to.

9. Have students write their names on the cards. Collect them and store for a later lesson.

LEARNING OUTCOME: Ability to devise a technique for measuring and comparing temperature at different locations.

****

DEVELOPMENT: 4B-1 Heat Transfer
Page T-408/S-222 Evidence of Heat Transfer (15-25 min.)

PURPOSE: Introduce heat as a form of energy and the concept of a heat transfer system.

ADVANCE PREPARATION: Materials - candle
- matches

Language Cards/Key Signs
energy
source

TEACHING SUGGESTIONS:

1. Begin the lesson with a quick review of system, energy giver, energy receiver, and energy transfer.

2. Light a candle. Ask the students which is warmer, the flame of the candle or their hands. Explain that heat can transfer from a energy giver to an energy receiver. Also heat transfers from a warmer object to a cooler object.

3. The teacher, not students, should put his/her hands near the flame as if trying to warm hands. Ask the students what is the energy giver and what is the energy receiver. (candle-hands)

4. Illustrate on blackboard how the warmer object is the energy giver and the cooler one is the energy receiver.

flame - hands
warm cool
energy giver energy receiver

5. Explain that when energy transfers, a change in temperature happens. Let students feel the teacher's warm hands.

6. Have students look at the picture's on page 222. Ask students to name the heat energy source and which is the energy giver and the energy receiver in each.

7. Have students read the first two paragraphs on page 222. Teacher should ask numbered questions for students to respond to.

DESIRED LEARNING OUTCOME: Ability to describe heat as a form of energy, evidence of heat transfer in a system, and tell which of object in a system is the heat energy giver and which is the heat energy receiver.

****

DEVELOPMENT: 4B-1 Heat Transfer
Pages T-409/S-223 Conductors of Heat (90-100 min.)

PURPOSE: Extend the concept of energy conductors to conductors of heat energy through the testing of phases of matter for heat conduction.

ADVANCED PREPARATION: Materials - thermometers
- clock or watch
- vials
- sand
- soil
- sugar
- cooking oil
- syrup
- plastic wrap
-scissors
- rubber bands
- 3 direction charts
Answer sheets as follows

Solid

	sand	soil	sugar
temp. with vials only			
temp. with hands around vials			

Liquid

	sand	soil	sugar
temp. with vials only			
temp. with hands around vials			

Gas

	sand	soil	sugar
temp. with vials only			
temp. with hands around vials			

You may wish to teach this lesson over a period of days since the recording of the three phrases of matter will take at least 25 minutes each.

Read over the directions in the student text. Paraphrase these directions onto three separate charts - one for solid - liquid - gas activities.

Sample Direction Chart

1. Fill 1 vial ½ full with sand, 1 vial ½ full of soil, and 1 vial ½ full of sugar.
2. CAREFULLY push a thermometer into the vial. Look at picture in your book. DO NOT push too hard.
3. Now fill the vials to the top. The bulb of the thermometer should be covered.
4. Wait 3 minutes. Look at the thermometer and write down the temperatures of each solid.
5. Put both of your hands around 1 vial.
6. Wait 8 minutes. Look at the thermometer and write down the temperature of the solid.
7. Do the same thing again for the other 2 vials. Don't forget to write down the temperatures.

TEACHING SUGGESTIONS:

1. Review matter and its 3 phrases - solid, liquid, and gas.
2. Place the word conductor on the board. Explain that matter through which energy can travel is called a conductor. If heat energy can go through an object, then that object is a conductor. Have students read first two paragraphs on page 223.

Language Cards/Key Signs
matter
solid
liquid
gas
conductor
vial
slit

Identification Cards
(one for each material listed in advanced preparation)

3. Place Solid Direction Chart in view of all students. Go over the directions with the students making sure they understand what they are to do.
4. Distribute answer sheets, pencils, 3 thermometers, clocks or watches, and 5 vials to each group of 2.
5. Have the students begin the activity following the direction chart carefully. Explain that students should share duties. Circulate around the room providing help when necessary.
6. Let the students test the solids and record their results. At this point, the activity may be stopped and the lesson continued another day. Collect answer

sheets and have students clean up.

7. Repeat steps 3, 4, 5, 6 using liquid direction chart and cooking oil. water, and syrup instead of the solids.

8. Repeat steps 3, 4, 5, 6 using gas direction chart, plastic wrap, rubber bands and vial.

9. Discuss with the students the results of their tests. You may wish to use the numbered questions as a guide. Place class results on the chalkboard. Compare their results by type of conductor, solids, liquids, and gases. Expect wide variations because students have different body temperatures and their hands differ as energy givers.

DESIRED LEARNING OUTCOME: Ability to compare the conductivity of solids, liquids and gases.

****

APPLICATION: 4B-1 Heat Transfer
Page: T-412/S-226 The Celsius Scale (15-25 min.)

PURPOSE: Apply what has been learned about temperature scale to introduce the celsius scale.

ADVANCED PREPARATION: Materials - celsius thermometers
- rulers
- measuring cups
- thermometers for lesson 4B-1 p. 220

TEACHING SUGGESTIONS:

Language Cards/Key Signs
celsius
scale
marks
internationally

1. Place materials on a table in front of the room. Explain to the students that all the objects on the table are the same in some way. See if students can come up with how they are the same.

2. Place the word scale on the board. Explain that a scale is a system of marks. (Show students the marks on all the objects) That the marks have the same amount of space between them and are numbered in order. (Show to students)

3. Have the students read page 226 or teacher may paraphrase. (You may need to explain that internationally means world wide)

4. Let the students take turns reading aloud the temperatures on the pictured thermometers.

5. Distribute celsius thermometers. Have the students go about the room finding hot and cold spot and recording the celsius temperature.

6. Conclude lesson by asking students the numbered questions on page 226. Encourage the use of the term celsius when students report temperatures in the celsius scale.

DESIRED LEARNING OUTCOME: Ability to read temperature on a celsius scale thermometer.

APPLICATION: 4B-1 Heat Transfer
Page T-413/S-227 Saving Heat (15-25 min.)

PURPOSE: Extend the concept of insulators to heat energy insulators, and to apply that concept to heat insulation used in buildings.

ADVANCED PREPARATION: Materials - blanket fiberglass

TEACHING SUGGESTIONS:

Language Cards/Key Signs
insulator
blanket fiberglass
cellulose
lining

1. Place the word insulator on the board. Explain that matter through which energy can not travel is called an insulator. If heat energy can not go through an object then the object is an insulator.

2. Show students some blanket fiberglass. Explain that heat can not go through it so therefore it is an insulator. Pass around for students to observe.

3. Have students read the first paragraph on page 227.

4. Have students look at the pictures on page 227. Ask the students where and why the insulation is being put in the homes.

5. Ask the numbered questions for students to respond to.

DESIRED LEARNING OUTCOME: Ability to describe how insulation is used to keep object warm or cool.

****

EVALUATION: 4B- 1 Heat Transfer
Page T-414/S-228 Recognizing Heat Systems (20-30 min.)

PURPOSE: To evaluate the students' performance in identifying insulated objects, energy givers and energy receivers, conductors in a heat energy system and translating numerical temperatures into words.

TEACHING SUGGESTIONS:

1. Read "Recognizing Heat Systems" and explain the type of responses expected from the children. Go over all vocabulary. If necessary the teacher should paraphrase each question, allowing time between each for student to respond.

2. Allow the students time to complete the evaluation.

3. Grade and record correct responses with each student individually.

****

Level 4 Unit 4 Exploring Energy

Part B Heat Variables, Lesson Cluster 4B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-421	Introduction	Kinds of Matter	20-30 min.
T-422	Development	Color	20-30 min.
T-424	Development	Amount of Matter	30-40 min.
T-425	Application	Choosing Clothes	15-25 min.
T-426	Evaluation	Finding Variables	15-25 min.

B. MATERIALS: See Materials List on page T-417.

FILMSTRIP INFORMATION: Filmstrip Set XII, Conduction Systems, is appropriate for use in this unit.

INTRODUCTION: 4B-2 Heat Variables
Page T-421/S-229 Kinds of Matter (20-30 min.)

PURPOSE: Introduce kind of matter as a variable in a heat energy system.

PREREQUISITE: Exposure to the term variable

ADVANCED PREPARATION: Materials - books (with dark covers)
- celsius thermometers

Direct sunlight is needed for this lesson. Therefore you will need to schedule this lesson on a sunny day and at a time when direct sunlight shines into, or near, your room.

Language Cards/Key Signs
variable

TEACHING SUGGESTIONS:

1. Begin the lesson with a brief review of the term variable. (A variable is something in a system that can change. When a variable changes, the interaction changes). Explain to the students that, in this cluster, they will be investigating variables in heat systems.

2. Have the students read page 229. Go over the directions with the students, making sure they understand what to do.

3. Explain to the students that they are to record high and low temperatures of objects. Draw an example of a chart on the chalkboard.

4. Distribute the materials and have the students do the activity. Use books with dark covers for best results. Have students choose other objects from the classroom to test.

5. Circulate around the room providing help as needed.

6. Draw a large chart on the chalkboard and have the students supply the data when they have tested all of the objects.

7. Teacher should ask numbered questions for students to respond to.

8. Write the heading "Variable in Heat Transfer" on the chalkboard. Ask students what variable changed during testing (kind of matter). Record the variable under the heading. Add other variables to the list as the students procede through this cluster.

DESIRED LEARNING OUTCOME: Ability to identify kind of matter as being a variable in a heat system and to describe its effect using temperature readings.

****

DEVELOPMENT: 4B-2 Heat Variables
Page T-422/S-230 Color (20-30 min.)

PURPOSE: Introduce color as a variable in a heat energy system.

ADVANCED PREPARATION: Materials - vials
- thermometers
- water
- food coloring
- ink

OPTIONAL: Direction Chart

Language Cards/Key Signs
permanent

Direct sunlight is needed for this lesson. Therefore you will need to schedule this lesson on a sunny day and at a time when direct sunlight shines into or nears your room. You can teach lesson (3) Amounts of Matter, prior to this lesson because of weather conditions.

Liquids used in this lesson may be prepared in advance allowing the solutions to reach room temperature at the same time, thereby eliminating one variable with which students might be concerned.

TEACHING SUGGESTIONS:

1. Explain to students that in this lesson they will be testing to see if color has an effect on temperature.

2. Have students read page 230-231 or go over directions on direction chart with students. Be sure students understand what they are to do.

3. Ask students to predict what will happen to varying colors of water both in and out of the sun. Record predictions on board.

4. Distribute the materials and have the students begin the lesson. While students are waiting the 15 minutes, ask them to record their temperatures next to their predictions on the chalk board. Compare the two temperatures.

5. Circulate around the room providing help as needed.

6. Record the remainder of the data on the chalkboard when students have completed the lesson. Go over data with students.

7. Teacher should ask numbered questions for students to respond to.

8. Ask the student what variable changed during testing (color). Record the variable under the heading, "Variable in Heat Transfer."

DESIRED LEARNING OUTCOME: Ability to describe the changes that color causes in a heat energy system.

****

DEVELOPMENT: 4B-2 Heat Variables
Page T-424/S-232 Amount of Matter (30-40 min.)

PURPOSE: Introduce amount of matter as a variable in a heat energy system.

ADVANCED PREPARATION: Materials - hot and cold water
- glasses or cups - different sizes
- celsius thermometers
optional - direction chart

TEACHING SUGGESTIONS:

Language Cards/Key Signs
amount

1. Have the students read the title of the lesson "Amounts of Matter." Ask the students what it means. Be sure students understand the term 'amount.'

2. Have the students read page 232 or go over directions on direction chart. Make sure students understand what they are to do.

3. Distribute the materials and have the students begin the lesson. Caution students to be careful with the hot water.

4. Circulate around the room providing help where needed.

5. Discuss results when students have finished. Using student data, draw a chart on the chalkboard showing the temperature differences.

6. Teacher should ask the numbered questions for students to respond to.

7. Ask the student what variable changed during testing (amount of matter). Record the variable under the heading "Variables in Heat Transfer."

DESIRED LEARNING OUTCOME: Ability to identify amount of matter as a variable in a heat system.

****

APPLICATION: 4B-2 Heat Variables
Page T-425/S-233 Choosing Clothes (15-25 min.)

PURPOSE: Apply the knowledge of variables in a heat energy system to choosing clothing in hot or cold weather.

ADVANCE PREPARATION: Materials - list of variables from three previous lessons

TEACHING SUGGESTIONS:

1. Begin the lesson by having students review the three heat variables, kind of matter, color, and amounts of matter. Refer to chart you begin in Lesson 1 of this cluster.

2. Have students read the first paragraph on page 233. Ask students how knowing about variables in heat energy can help them to decide what clothes to wear.

3. Have students read through the directions and do the activity. Tell students to keep in mind the list of heat variables while doing the activity.

4. Go over the student responses with them when they have finished the activity. Teacher should ask numbered questions for students to respond to.

5. Extend the lesson by asking the students to design a piece of clothing for one of the following weather conditions.
    a. snow storm 0°C
    b. hot, dry, sunny, 33°C
    c. Windy, 21°C

DESIRED LEARNING OUTCOME: Ability to determine what kind of clothing is suitable to wear on hot and cold days by using variables in heat transfer.

* * *

EVALUATION: 4B-2 Heat Transfer
Page T-426/S-234 Finding Variables (15-20 min.)

PURPOSE: To evaluate the students' performance listing variables that would cause temperature changes in heat systems.

TEACHING SUGGESTIONS:

1. Read "Finding Variables" and explain the type of responses expected from the children. If necessary, the teacher should paraphrase each questions, allowing time between each for student to respond to.

2. Allow the students time to complete the evaluation.

3. Grade and record correct responses with each student individually.

* * *

Level 4 Unit 4 Exploring Energy

Part C Electric Energy, Lesson Cluster 4C-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-432	Introduction	Electricity	20-30 min.
T-435	Development	Electric Circuits	15-25 min.
T-436	Development	Connecting Circuits	20-30 min.
T-438	Application	Using circuits	20-30 min.
T-439	Evaluation	Knowing About circuits	15-25 min.

B. MATERIALS: See Materials List on page T-429.

FILMSTRIP INFORMATION: Filmstrip Set XII, Conduction Systems, is appropriate for use in this unit.

INTRODUCTION: 4C-1 Transfer of Electricity
Page T-432/S-236 Electricity (20-30 min.)

PURPOSE: Introduce the concepts of electric energy transfer and of a circuit.

ADVANCE PREPARATION: Materials - batteries
- bulbs
- wire (30 cm (12 in.) pieces)

Language Cards/Key Signs
electricity

Identification Cards
bulb
battery
wire

Use uninsulated aluminum wire. Copper is also acceptable but not iron or steel wire.

Background Information - As with other energy systems, an electrical energy system must have an energy giver and an energy receiver. An electrical energy giver can be a battery. Unlike many forms of energy, electrical energy requires a complete path or circuit from energy giver through energy receiver and back to the energy giver. This additional path from energy receiver back to the energy giver makes electrical conduction both exciting and frustrating for the students. They generally believe that a wire connected from the battery to the bulb should cause the bulb to light. The discovery that an extra pathis is needed is not really internalized by some students until many activities have been completed.

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to recall the forms of energy they know.

2. Explain to the students that they will now be learning about electricity. Write the term on the board. Explain that electricity is another form of energy. It is electrical energy and it can transfer through a system from energy giver to energy receiver.

3. Have the students read the directions and do the activity. Distribute materials.

4. Circulate around the room, encouraging the students to look for many ways to light the bulb. Attempting to find several patterns to light the bulb is very important as students will begin to make generalizations about the connections.

5. When students have finished, have them look at their drawings. Ask which objects they drew are the energy givers, energy receivers and what evidence of transfer of electricity did they see.

DESIRED LEARNING OUTCOME: Ability to cause a bulb to light by connecting a battery, wire, and bulb.

****

DEVELOPMENT: 4C-1 Transfer of Electricity
Page T-435/S-237 Electric Circuits (15-25 min.)

PURPOSE: Extend the concept of the transfer of electricity to circuits that are complete and not complete.

ADVANCE PREPARATION: Materials
- batteries
- bulbs
- wire (30 cm or 12 in. pieces)
- masking tape

Language Cards/Key Signs
path
circuit
trace
source

Identification Cards
bulb
battery
wire

TEACHING SUGGESTIONS:

1. Write the term circuit on the board. Explain that a circuit is a path that electricity travels through.

2. Have the students read the first 2 paragraphs. If students are unfamiliar with the term energy source, explain that an energy source is an energy giver.

3. Make sure the students understand the meaning of circuit and that electrical energy can only travel through a complete circuit.

4. Have the students look at the pictures on page 237. Ask students which circuits are complete and which are not complete.

5. Allow the students time to test the circuits. Demonstrate how to use masking tape to hold the wire in place.

6. Ask the students how their complete circuits are the same. Help students to realize that a wire from one end of the cell must go to the side of the light bulb, and a wire from the opposite end must connect to the base of the light bulb; and that it is not necessary for one end of the battery to go to a specific location - the bulb will light if either end is used.

7. Conclude the lesson by asking the numbered questions for the students to respond to.

DESIRED LEARNING OUTCOME: Ability to generalize about the connections needed to complete a circuit and relate their work to electrical energy transfer.

****

DEVELOPMENT: 4C-1 Transfer of Electricity
Page T-436/S-238 Connecting Circuits (20-30 min.)

PURPOSE: Extend the concept of a circuit to circuits connected in series and parallel.

ADVANCE PREPARATION: Materials - batteries
- wire
- bulbs
- paper
- pencils

Optional: cards with drawings of parallel and series circuits.

Language Cards/Key Signs
series
parallel
circuits

Identification Cards

Background Information - Basically, there are just 2 ways in which an electrical energy giver can be connected to an electrical energy receiver. These 2 ways are called parallel and series circuits.

In a series circuit, the energy must flow in a series from 1 receiver to the next until it returns to the energy giver. There is just one path the energy can follow in a series circuit. Thus if the circuit is broken, all parts of the circuit will not function.

In a parallel circuit there are many paths from energy giver to receivers. Thus, if the circuit is broken, the other receivers will continue to function.

TEACHING SUGGESTIONS:

1. Write the words series and parallel on the board. Point out that the word series refers to things or events that occur one after another. The word parallel refers to things or events that happen together.

2. Have students read the first paragraph on page 238. Ask students how the batteries are connected in a series circuit; a parallel circuit.

3. Have the students look at the pictures on page 238. Ask the students the italicized questions. If students are having difficulty, illustrate on the chalkboard the 2 different series.

4. Distribute materials and have the students set up 1 circuit in series and 1 in parallel. Circulate around the room providing help when necessary.

5. Ask the students to draw the circuit they made. Tell them to mark on their drawing where they plan to disconnect their circuits and then record the result after they do it.

6. Have each student draw his successful circuits on the board. Go over the results of the activity.

7. Repeat steps 2, 3, 4, 5, 6 for page 239 (insert word bulb for battery).

8. Teacher may ask numbered questions for student to respond to.

9. For more practice, teacher should prepare ahead of time, cards with drawings of series and parallel circuits. Cards may be used in several ways:
    1. hold up and student must identify the kind of series
    2. pass out and student must set up the circuit
    3. hold up and student must identify if it is the batteries or the bulbs that are in a series or parallel circuit
    4. play a card game similar to 'fish' where students must get 3 of the same kind of circuit before they can lay them down.

DESIRED LEARNING OUTCOME: Ability to identify and draw series and parallel circuits.

* * *

APPLICATION: 4C-1 Transfer of Energy
Page T-438/S-240 Using Circuits (20-30 min.)

PURPOSE: Apply a knowledge of energy givers, energy receivers and circuits in examining battery-operated objects.

ADVANCE PREPARATION: Materials - answersheets with italicized questions on and room for students to answer
- flashlights
- transistor radios
- battery operated games or toys

Language Cards/Key Signs
transistor radio

Identification Cards
transistor radio
flashlight

Perhaps the students could bring in some of the materials. The ideal amount would be one of each for each pair of students. However, the minimum equipment is one flashlight and one battery.

TEACHING SUGGESTIONS:

1. Explain to the students that they will be observing ways in which batteries are connected in battery operated objects.

2. Have students read the first paragraph on page 240. Divide class into groups of 2.

3. If you have enough, distribute the flashlights and transistor radios so that each group of 2 will have one each. Otherwise set up places in the room where students can manipulate and observe the materials. Distribute answersheets.

4. Have students do the activity. Explain to them they are to find the answers to the questions on their papers. Circulate around the room providing help where needed.

5. Go over the students' responses with them when they have completed the activity.

6. Point out to the students where the battery operated toys and games are. Ask the students to pick one and draw a picture of the circuit in that game. Label as to series or parallel.

DESIRED LEARNING OUTCOME: Ability to describe how batteries in battery-operated objects are connected.

****

EVALUATION: 4C-1 Transfer of Energy
Page T-439/S-241 Knowing About Circuits (15-25 min.)

PURPOSE: Evaluate performance in reference to the following objectives:
1. Identifying circuits that are complete.
2. Recognizing selected circuits connected in series.
3. Recognizing selected circuits connected in parallel.

TEACHING SUGGESTIONS:

1. Read "Knowing About Circuits" and explain the type of responses expected from the children. If necessary, the teacher should paraphrase each question, allowing time between each for student to respond.

2. Allow the students time to complete the evaluation.

3. Grade and record correct responses with each student individually.

****

Level 4 Unit 4 Exploring Energy

Part C Electric Energy, Lesson Cluster 4C-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-444	Introduction	The Energy Receiver	15-25 min.
T-445	Development	The Energy Giver	15-25 min.
T-446	Development	Conductors and Insulators	30-40 min.
T-448	Application	Electricity and Safety	15-25 min.
T-450	Evaluation	Knowing About Electricity	15-25 min.

B. MATERIALS: See Materials List on page T-441.

FILMSTRIP INFORMATION: Filmstrip Set XII, Conduction Systems, is appropriate for use in this unit.

INTRODUCTION: 4C-2 Variables in Circuits
Page T-444/S- 242 The Energy Receiver (15-25 min.)

PURPOSE: Extend the concept of variable in an energy system by introducing the energy receiver as a variable in an electrical energy system.

ADVANCE PREPARATION: Materials - batteries
- bulbs
- wire (30 cm)
- masking tape

Language Cards/Key Signs
variable

Identification Cards

TEACHING SUGGESTIONS:

1. Review the term variable. You may have the students recall the variables that affected heat. (amount of matter, color, kinds of matter, size)

2. Have students read page 242 and then distribute materials.

3. First instruct students to use 1 battery, 1 bulb and 1 wire and connect so the bulb lights. Circulate around the room providing help where needed. Ask the first italicized question in the book.

4. Now ask the students to predict what will happen when they use 2 bulbs.

5. Next, have the students use 1 battery, 2 bulbs, and 1 wire and connect so the bulbs light. Ask the 2nd italicized question.

6. Discuss the results of the activity. Teacher should ask the numbered questions for the students to respond to.

7. Have students test the circuits discussed in the numbered questions.

8. Ask students what the variable in the circuit was. (bulbs)

DESIRED LEARNING OUTCOME: Ability to show how an energy receiver can be a variable in the transfer of electrical energy.

****

DEVELOPMENT: 4C-2 Variables in Circuits
Page T-445/S-243 The Energy Giver (15-25 min.)

PURPOSE: Extend the concept of a variable in electrical energy systems by introducing the energy giver as a variable.

Language Cards/Key Signs

Identification Cards

ADVANCE PREPARATION: Materials - batteries
- bulbs
- wire
- masking tape

TEACHING SUGGESTIONS:

1. Have the students read page 243. Ask students to name the energy giver in the circuits with which they have been working (battery). Then ask the students how they think the energy giver could be a variable. Keep this question open ended.

2. Distribute materials. First instruct the students to use 1 battery, 1 bulb, and 1 wire and connect so the bulb lights. Circulate around the room providing help where needed.

3. Now ask the students to predict what will happen when they use 2 batteries.

4. Next have the students use 2 batteries, 1 bulb, and 1 wire and connect so the bulbs light. Ask the italicized question.

5. Discuss the results of the activity. Teacher should ask the numbered questions for the students to respond to. Have the students test the circuits discussed in the numbered questions.

6. Conclude the lesson by asking the students to name 2 variables on which the transfer of energy depends (energy giver and energy receiver).

DESIRED LEARNING OUTCOME: Ability to show how an energy giver can be a variable in the transfer of electrical energy.

****

DEVELOPMENT: 4C-2 Variables in Circuits
Page T-446/S-244 Conductors and Insulators (30-40 min.)

PURPOSE: Extend the concept of conductors and insulators to an electric energy system.

ADVANCE PREPARATION: Materials - student answersheet (see sample)
- batteries
- bulbs
- wire
- masking tape
- pencils with erasers
- paper clips
- plastic
- rulers
- metal washers
- paper
- Optional - direction chart

Language Cards/Key Signs
conductor
insulator

Identification Cards
objects used

Sample Answer Sheet - Have students place checks in appropriate columns.

Matter	Conductor	Insulator
pencil eraser		✓
metal	✓	
colored part		✓
point	✓	
paper clip	✓	
pastic ruler		✓
metal washer	✓	
paper		✓

TEACHING SUGGESTIONS:

1. Review the terms, conductor and insulator. Remind the students of conductors and insulators in lessons dealing with heat transfer.

2. Have students read the first 2 paragraphs on page 244.

3. Have students read the remainder of the lesson or go over the directions on the direction chart with the students. Be sure students understand what they are to do.

4. Stress the importance of making sure that the circuit works each time before using it as a tester. Distribute materials and answersheet.

5. Have students do the lesson. Circulate around the room providng help where needed. Stress that students test each object separately and then mark answersheet.

6. Go over the results of the test when the students have completed it.

7. Write the headings "Conductors" and "Insulators" on the board. Using students data, record the tested objects under the appropriate heading.

8. Teacher should ask numbered questions for students to respond to.

DESIRED LEARNING OUTCOME: Ability to construct an electrical tester and test objects for conduction or insulation.

****

APPLICATION: 4C-2 Variables in Circuits
Page T-448/S-246 Electricity and Safety (15-25 min.)

PURPOSE: To increase the students' awareness of the dangers of electricity and to apply it to ways in which objects in an electric energy system are made safe.

ADVANCE PREPARATION: Materials - variety of insulated wires (non insulated)
- small battery
- large battery

Language Cards/Key Signs
insulators
conductors

Identification Cards

TEACHING SUGGESTIONS:

1. Have the students read the first 3 paragraphs on page 246. Show students the difference between insulated and non-insulated wires.

2. Show the students a very small and a large battery. Ask them what the difference between the amount of electrical energy in them.

3. Have the students read the remainder of 246. Pass out the insulated wires that you have collected. Have the students describe the similarities and differences of the insulation.

4. Have the students read page 247. Have them look at the picture while teacher asks the italicized questions for them to respond to.

5. Teacher should ask the numbered questions for students to respond to.

DESIRED LEARNING OUTCOME: Ability to describe the insulation used to make electric objects safe and to name circumstances in which electric objects could be dangerous.

****

EVALUATION: 4C-2 Variables in Circuits
Page T-450/S-248 Knowing About Electricity (15-25 min.)

PURPOSE: Evaluate performance in reference to the following objectives:
1. Identifying objects that are conductors of electric energy.
2. Identifying objects that are insulators of electric energy.
3. Naming the safety covering on wires.
4. Identifying in which of several circuits a light would shine brightest.

TEACHING SUGGESTIONS:

1. Read "Knowing About Electricity" and explain the type of responses expected from the children. If necessary, the teacher should paraphrase each question, allowing time between each question for student to respond to.

2. Allow the students time to complete the evaluation.

3. Grade and record correct responses with each student individually.

****

Level 4 Unit 4 Exploring Energy

Part C Electric Energy, Lesson Cluster 4C-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-457	Introduction	One Form to Another	20-30 min.
T-458	Development	Energy Chains	25-35 min.
T-460	Application	Static Electricity	25-35 min.
T-461	Evaluation	Energy Transformation	20-30 min.

B. MATERIALS: See Materials List on page T-453.

FILMSTRIP INFORMATION: Filmstrip Set XII, Conduction Systems, is appropriate for use in this unit.

INTRODUCTION: 4C-3 More About Energy Transfer
Page T-457/S-249 One Form to Another (20-30 min.)

Language Cards/Key Signs
transferred
interacts
transform
energy transformation

Identification Cards

PURPOSE: Introduce the concept of energy transformation.

ADVANCE PREPARATION: Materials - None.

TEACHING SUGGESTIONS:

1. Have the students name all the different forms of energy they know (light, motion, sound, heat, electric, magnetic).

2. Place their responses on the board then ask the students to come up with 2 or 3 examples of each and write under appropriate heading on the board.

3. Have the students read page 249 or teacher may paraphrase. Be sure students understand Energy Transformation - (when an energy receiver becomes an energy giver it transform or changes the kind of energy it receives).

4. Have students rub their hands together fast. Ask the 2 italicized questions on page 249.

5. Next have students clap their hands together. Ask the 2 italicized questions on page 249. Repeat step 4 only this time have the students run.

6. Review definition of energy transformation.

DESIRED LEARNING OUTCOME: Ability to demonstrate and describe an energy transformation.

****

DEVELOPMENT: 4C-3 More About Energy Transfer
Page T-458/S-250 Energy Chains (25-35 min.)

PURPOSE: Extend the concept of energy transformation to energy chains.

ADVANCE PREPARATION: Materials - paper
- pencils
- textbook

Language Cards/Key Signs
energy chain
energy transformation

Identification Cards

TEACHING SUGGESTIONS:

1. Place a book and a pencil on a table. Push the book into the pencil. Ask the students what objects were involved in the system. Write responses on board in form of chain (hand → book → pencil).

2. Next ask the students what kind of energy was involved between the hand and the book. (motion) Write response under the 2 terms. Then ask what kind of energy was involved between the book and the pencil. (motion) Write the response under the 2 terms.

$$\text{hand} \underset{\text{motion}}{\rightarrow} \text{book} \underset{\text{motion}}{\rightarrow} \text{pencil}$$

3. Explain to students that this is called an energy chain (point to board). When energy is transferred more than once in a system, it is called an energy chain. Ask the students how many times energy was transferred in this system (2).

4. Ask students to read first 2 paragraphs on page 250. Have them look at the pictures while you ask the italicized questions. Write the energy chains on the board.

5. Be sure students understand how to write an energy chain. If more examples are necessary, set up various systems for students to write energy chains to.

6. Have students read page 251 and do the activity. Have students take turns drawing energy chains on the chalkboard and reading the energy chains in words.

7. Teacher should ask the numbered questions for students to respond to.

8. Additional practice of setting up systems and having the students write and read energy chains may be necessary.

DESIRED LEARNING OUTCOME: Ability to write energy chains using words and arrows.

****

APPLICATION: 4C-3 More About Energy Transfer
Page T-460/S-252 Static Electricity (25-35 min.)

PURPOSE: Apply the concept of energy transformation to situations where static electricity is produced.

ADVANCE PREPARATION: Materials - paper

Language Cards/Key Signs
static electricity

Identification Cards

Background Information - The relative humidity on the day you do this activity will have a great deal to do with how successful it is. It works best during periods of low humidity, especially in a heated room during the winter.

If you find that the paper-desk activity does not work as dramatically as you would like, have the students try rubbing an inflacted ballon on a wool or polyester shirt or blouse. Afterwards have them try to "stick" the balloon on the shirt and then on a classroom wall.

TEACHING SUGGESTIONS:

1. Begin the lesson by having students take turns scuffing their feet on a rug and then touching a doorknob.

2. Write the word 'static electricity' on the board. Ask students what they think it means. Guide students to form definition of 'static electricity'.

3. Have students read page 252 and do the activity. Instruct them to draw an energy chain for both activities.

4. Write the 2 energy chains on the board.

5. Teacher should ask numbered questions for students to respond to.

DESIRED LEARNING OUTCOME: Ability to make an energy chain using static electricity and themselves.

****

EVALUATION: 4C-3 More About Energy Transfer
Page T-461/S-253 Energy Transformation (20-30 min.)

PURPOSE: Evaluate performance in relation to the following objectives:
1. Identifying the energy transformations present in energy systems.
2. Identifying several energy chains.

TEACHING SUGGESTIONS:

1. Have students tell what objects they see in each picture. Ex. 1. electric oven, light, cake baking. If necessary the teacher should paraphrase each question, allowing time between each for students to respond to.

2. Have students read "Energy Transformation" and explain the type of response expected from the children.

3. Allow the students time to complete the evaluation.

4. Grade and record correct responses with each student individually.

****

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LEVEL 4

SIGNED VOCABULARY AND LANGUAGE INDEX
FOR
SCIENCE FOR THE HEARING IMPAIRED

Instructions for use of this index with the accompanying signed videotapes are found in the Introduction to the Program. This index should be used as a script when viewing the signed videotapes for the specific SFHI cluster or section of interest.

Each part of the videotape is preceded by an indication of the specific location (level, unit, part, Cluster and Lesson) of the item presented. Each item within a lesson is first presented in American Sign Language (ASL) followed by a Manually Coded English (MCE/SEE) presentation of the same item. When a lesson list is completed the title of the next lesson is given, followed by a presentation of each new lesson item in ASL and MCE.

Teachers should view the videotape in planning for each new cluster (2-5 minutes per cluster). It is also suggested that teachers view and practice the signs presented with their classes following lesson experiences or as a review. The videotape can be used as a visual dictionary when the children have forgotten the sign.

The Signed Vocabulary and Language Videotapes are available for purchase and/or copying by writing

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SCIENCE FOR THE HEARING IMPAIRED

Signed Vocabulary for Level 4

Lesson Title and Key Signs

Cluster 1A-2 Preparing for Later

1 Start a Fruit Fly Population
egg
pupa
larva
adult
stages
population
Fruit Fly
banana
gauze
container
dry yeast
masking tape
food mix
rubber bands

2 Start A Bean Population
factor
bean name
centimeter stick
weeds
pebbles

3 Start Other Bean Plants
degree celcius
heat
temperature
experiment
graph
aluminum foil

4 Bean Plant Growth
growth
cycle stages
structures (parts)

5 A Cricket Environment
moisture
nymph
crickets
layers
terrarium
plant names
humas (peat)
cover screen

Lesson Title and Key Signs

Cluster 1A-3 Observing Factors

1 Seeds and Heat
temperature
the bean plants

2 Bean Plants and Water
make observations
experiment
graph paper
measure
volume
measurement
graduated cylinders
milliliter (ml)
cubin centimeter
liter

3 Fruit Flies and Heat
Fruit Flies
desk lamps
Celcius thermometer
experiment
vial

4 Another Kind of Record
graph
histogram
range
record (noun/verb)

5 Recognizing Environmental Factors

6 Keeping Track

Cluster 1A-1 What Is An Environment

1 A Factor Search
factor
environment
property
glossary
organism
surrounding
object
interact

Lesson Title and Key Signs

Cluster 1A-1 (cont)

2 Adding Up the Factors
heat
light
air
water
dark
sun
shade

3 Factors for People
helpful
harmful
factors

4 Environments Everywhere

5 Recognizing Environments

Cluster 1B-1 Animals Cause Changes

1 Mealworms and Air
measure
change
handle
danger
chemical
safety
brom thymol Blue (BTB)
mealworms
vial
cardboard
masking tape
graduated cylinder

2 Changes That Help
an animal
helpful
harmful

3 Changes That Harm

4 Starfish Attack
a marine biologist
a reef
some coral polyps
a crown-of-thorns
globe
Australia
The Great Barrier Reef

Lesson Title and Key Signs

5 Mealworm Growth
growth
a grain beetle
development
stages
a larvae
cheesecloth

6 Animals Change Environments

Cluster 1B-2 Plants Cause Changes

1 Plants and Water
an experiment
constant variable
a centiliter
measurement
same, different
cup (pot)
some soil
a graduated cylinder
a collecting jar

2 Plants and Air
environmental factor
to investigate
apparatus cards

3 Plants and Erosion
erosion

4 Soil Erosion

5 Changes by Plants
some plants
helpful
harmful
some environmental factors
temperature
air
rainfall
excursions

Cluster 1B-3 People Cause Changes

1 You and Air
air
to investigate
to change
plastic bag
vial

Lesson	Title and Key Signs
Cluster 1B-3 (cont)	
1 (cont)	BTB indicator
2	People Change Air pollution smoke
3	How People Change Land some trash some litter some garbage
4	Changing the Water Factor pollution clean dirty
5	Changing Other Populations endangered species
6	Noise in the Neighborhood
7	What Do You Think
Cluster 1C-1	Very Slow Changes
1	A Field or Forest Trip
2	From Field to Forest slow change stage maple forest environment forest ages
3	Capes and Beaches cape bay sediment movement fast/slow river water stream water bay water ocean water creek water cape lake water brook water island bayou

Lesson	Title and Key Signs
4	The Grand Canyon plateau
5	Recognizing Slow Changes
Cluster 1C-2	Sudden Changes
1 change sudden moist	Cause a Sudden Change
2	Disasters disasters sudden change blizzard flood volcano earthquake fire predict banks
3	Recognizing Sudden Changes
Cluster 1C-3	Regular Changes
1	Sunrise-Sunset sunrise sunset seasons winter summer spring fall
2	Jobs and Changes career job seasonal evidence clues
3	Recognizing Regular Changes

Lesson	Title and Key Signs
Cluster 2C-1	Light Through Matter
1	Objects and Light translucent transparent opaque properties matter
2	Objects and Shadows shadow objects vial paint
3	What Does A Shadow Show? cast shadow cast
4	Shapes and Light curved flat pattern
5	Looking Through Liquids liquid enlarge
6	Making Light Bend bent refract refraction
7	Light and Shadows X-ray aquarium
8	Light Through Objects
Cluster 2C-2	Looking Through Lenses
1	Exploring With Lenses lens curved viewed
2	Bringing Light Together focal point light safety fire focus
2 (cont)	distance measure centimeter angle focal length magnifying glass
3	Focus A Vial arrow vial paper
4	Making Objects Look Bigger magnify magnification power of magnification times
5	Images image spot picture retina optic nerve iris lens pupil cornea
6	All About Lenses
Cluster 2A-1	Kinds of Matter
1	Getting Ready measure size centimeter square triangle rectangle circle
2	Pacing Objects By Properties shape identify property
3	Describe The Missing Object missing object

Lesson	Title and Key Signs
Cluster 2A-1 (cont)	
4	Many Kinds of Matter describe matter heavy light leather rubber metal plastic wood transparent opaque translucent flexible pliable colors shiny dull wallet eraser plastic scoop emery board spoon watch
5	Useful Metals properties aluminum copper gold silver zinc brass chrome nickel pewter iron
6	Recognizing Properties
Cluster 2A- 2	Phases of Matter
1	Matter Has Phases phase phases of matter matter solid liquid gas

Lesson	Title and Key Signs
2	Some Mysterious Matter
3	Describing Quicksand safety danger panic properties quicksand
4	Gases air oxygen carbon dioxide dry ice perfume cologne
5	Phases of Foods cafeteria phase of matter
6	Solids, Liquids and Gases
Cluster 2A-3	Arrangement of Matter
1	What Is Structure? investigate describe structure properties arrange external internal
2	Functions Your Way function structure fruit names vegetable names screwdriver toothpick tongue depressor stem seed root leaves fruit

Lesson	Title and Key Signs
Cluster 2A-3 (cont)	
3	Parts and Properties arrangement parts structure
4	Structure and Function
Cluster 2B-1	Looking At Layers
1	Making Layers layers settle layering sediment stove/pebble soil sand jar lid
2	What Is A Layer? layer properties piled lint collage
3	A Kind of Layered Rock delta river mouth sediment bits sedimentary rocks sandstone shale conglomerate limestone
4	Layers In Trees rings growth
5	Lots of Layers
Cluster 2B-2	Looking Inside Rocks
1	Rock Particles composition
1 (cont)	safety mineral sand hammer safety goggles plastic logs
2	Kinds of Rocks formation deposited pressure sedimentary igneous metamorphic properties limestone granite slate schist quartz shiny striped rough smooth
3	Observing Crystals safety solution saturated crystals borax paper clip pencil hand lens/magnifying glass plastic spoon pot holders water heater salol
4	Crystals symmetrical surfaces crystal clumps
5	Ores metal mineral ore mines pits copper gold

Lesson	Title and Key Signs
Cluster 2B-2 (cont)	
5 (cont)	iron mercury uranium nickel platinum silver zinc aluminum lead
6	Rocks and Minerals
Cluster 3A-1	What Is A Pattern?
1	Rhythm Patterns music pattern beat rhythm instrument notes cymbals tambourine metronome
2	Patterns of Motion track footprint record highway tire tracks erosion windshield wipers animal tracks
3	Making Patterns arrange pattern related relative size shape
4	People Use Patterns daily pattern
5	Symmetrical Patterns symmetry asymmetrical

Lesson	Title and Key Signs
5 (cont)	patterns butterfly
6	A Look At Patterns relative (in relation to) pattern arrange
7	Recognizing Patterns
Cluster 3A-2	Patterns Tell Stories
1	Flip Book Patterns pattern picture series sequence flip book film reel frame
2	Looking for Story Clues clue events
3	Tracks and Facts infer evidence observe
4	Pattern Stories Everywhere inference
5	Stories and Patterns
Cluster 3A-3	Patterns and Predictions
1	Counting on Patterns predict record casts safety window frame apparatus
2	Bouncing Ball Patterns record predict observe bounce

Lesson	Title and Key Signs
Cluster 3A-3 (cont)	
2 (cont)	meter stick basketball ping pong ball base ball tennis ball
3	Predictions About The Environment & Predictions About The Moon moon season sunrise sunset phase record graph
4	Predicting From Patterns
Cluster 3B-1	Patterns of Support
1	Building A Strong Bridge weak strong sag pattern structure
2	Paper Supports shape cylinder triangle circle square rectangle
3	Using Support Patterns geodesic dome architect design support
4	Natural Support Patterns skeleton rings external internal support
5	Structures That Support

Lesson	Title and Key Signs
Cluster 3B-2	Patterns of Structure
1	Find the Balance Point balance balance point meter stick weight
2	Balancing Different Weights cylinder weight seesaw
3	A Balance Beam
4	Balance and Shape shape square rectangle triangle circle
5	Mobiles balance points mobiles decoration mobile string construction paper
6	Structures That Balance
Cluster 3C-1	All Sorts of Cycles
1	Pendulum Cycles pendulum arc cycles series string weight
2	Body Cycles pulse breath(e) lungs blood swell heartbeat stop watch

Lesson Title and Key Signs

Cluster 3C-1 (cont)

3 Life Cycles
life cycle
growth cycle
stages
blossoms
Monarch butterfly

4 School Day Cycles
cycle
daily events
behavior
activities
cyclic
non-cyclic

5 Sound Cycles
round
song

6 Exercise Cycles

7 What Is A Cycle?
events
hour glass

8 Working With Cycles
work
factory

9 Recognizing Cycles

Cluster 3C-2 The Water Cycle

1 A Change of Phase
phase
liquid
solid
gas
evaporate
boil
condense
heater
ice

2 Water Comes Out of Air
condenses
condensation
dew

Lesson Title and Key Signs

3 Water Goes Into Air-See It Yourself
evaporate
steam
humid

4 Putting the Cycle Together
evaporate
condensation
water cycle

5 Cycle In A Cycle
cycle
rain

6 Make A Cycle

Cluster 4A-1 What Is Energy?

1 Interacting Systems
interact
evidence
system
properties

2 Systems and Energy
energy
energy giver
energy receiver

3 Energy Transfer
energy transfer

4 Energy Everywhere
subway

5 Evidence of Energy

Cluster 4B-1 Heat Transfer

1 Thermometers
temperature
thermometers
bulb

2 Evidence of Heat Transfer
energy
source

Lesson	Title and Key Signs
Cluster 4B-1 (cont)	
3	Conductors of Heat matter solid liquid gas conduction vial slit
4	The Celsius Scale celsius scale marks internationally
5	Saving Heat insulator blanket fiberglass cellulose lining
6	Recognizing Heat Systems
Cluster 4B-2	Heat Variables
1	Kinds of Matter variable
2	Color permanent
3	Amount of Matter amount
4	Choosing Clothes
5	Finding Variables
Cluster 4C-1	Electric Energy
1	Electricity electricity bulb battery wire
2	Electric Circuits path circuit trace
2 (cont)	source
3	Connecting Circuits series parallel circuits
4	Using Circuits transistor radio flashlight
5	Knowing About Circuits
Cluster 4C-2	Variables In Circuits
1	The Energy Receiver variable
2	The Energy Giver
3	Conductors and Insulators conductor insulator
4	Electricity and Safety insulators conductors
5	Knowing About Electricity
Cluster 4C-3	More About Energy Transfer
1	One Form to Another transferred interacts transform energy transformation
2	Energy Chains energy chain energy transformation
3	Static Electricity static electricity
4	Energy Transformation

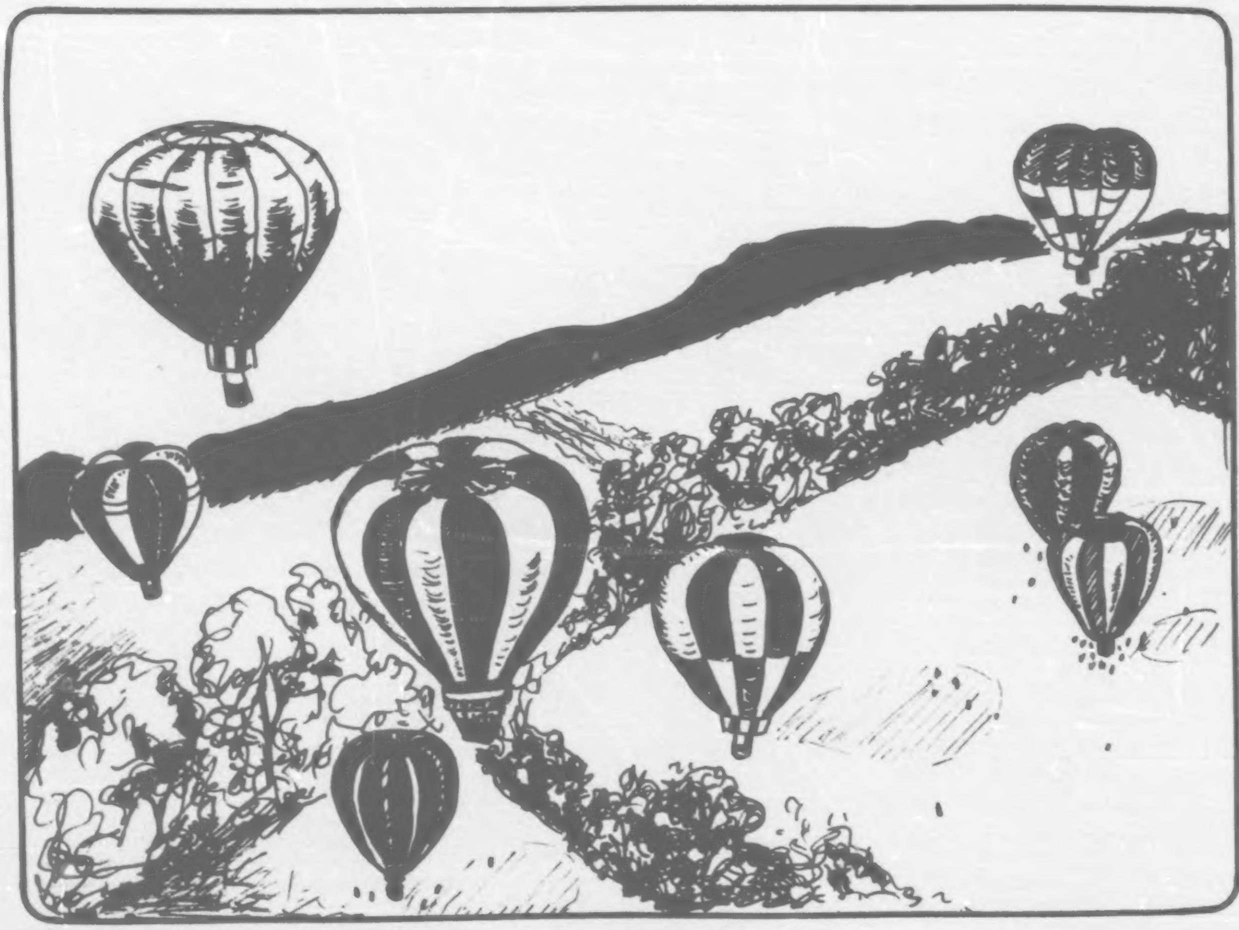
Teachers Guide for Level 5

SCIENCE

adapted

For the Hearing Impaired

Dennis W. Sunal
Cynthia Szymanski Sunal



SFHI

SCIENCE

for

the HEARING IMPAIRED

Level 5

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Appendix

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Introduction

Many teachers and administrators have long been concerned with the lack of appropriate science materials and aids for teaching hearing impaired youth. This disadvantage is most critical for the middle childhood aged student in special hearing impaired classrooms or joined with their hearing peers in regular classrooms. Many students have been denied adequate access to science as a discipline because it was too difficult or because ways to present it to hearing impaired youth beyond traditional methods could not be envisioned.

To meet this concern the Science for the Hearing Impaired (SFHI) project was proposed. Its primary aim was to make available, for the first time, a complete sequenced science program for the hearing impaired which would foster the development of abilities and attitudes in the sciences in hearing impaired youths at this critical age.

This volume represents two years of planning, development, classroom testing, evaluating, and rewriting to produce a science program effective for hearing impaired middle childhood youths. To date, the success of these materials with teachers and students has been assuring. The SFHI introductory guide which describes the program materials, teaching strategies and use of program components, along with the individual program teacher's guides presents all essential information needed for maximizing learning for this special population of youth.

Level 5 Unit 1 Adaptations

Part A Outside Adaptations, Lesson Cluster 1A-1

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-25	Enrichment	Toothpick Hunt	40-45 min.
T-24	Introduction	Structures Have Functions	30-40 min.
T-26	Introduction	Structures That Help	45-50 min.
T-28	Development	Protective Color and Shape	40-45 min.
T-30	Development	Defense Structures	30-35 min.
T-31	Development	Protective Coverings	30-35 min.
T-32	Application	Plant Protection	40-45 min.
T-33	Application	Human Coverings	40-45 min.
T-34	Evaluation	Finding Adaptations	40-45 min.

NOTE: The enrichment lesson has been made a definite part of the cluster.

B. MATERIALS: Add the following to the list on page T-21 - a live chameleon and a live turtle.

FILMSTRIP INFORMATION: Filmstrip Set X, Structural Systems and XVII, Adaptations are appropriate for use in this unit.

ENRICHMENT: Lesson Cluster 1A-1 Protective Adaptations
Page T-25/S- Toothpick Hunt (40-45 min.)

PURPOSE: To demonstrate how color can help to conceal objects in an environment. This lesson does not appear in the student text.

PREREQUISITES: Ability to identify and name the colors red, yellow and green.

ADVANCE PREPARATION: Materials
- 50 red toothpicks*
- 50 green toothpicks *
- 50 yellow toothpicks*
- copy of the following chart on board or transparency
- stopwatch or clock/watch with a second hand

*If colored toothpicks are not available, dye other toothpicks.

Color	Number Predicted	Number Found
red		
yellow		
green		

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they will be having a toothpick hunt.

2. Show the class the colored toothpicks. Explain to them that the toothpicks will be scattered on a lawn and that they are to try to find as many of them as they can in 60 seconds.

3. Teacher asks the students to predict how many toothpicks the class will find. Record student predictions on the chart on the board. Make sure the students are aware that there is a possible total of 50 toothpicks per color.

4. Take the class outside and while students are not watching, the teacher scatters toothpicks on the grass.

5. Explain to the students that the timer will say "go" to begin the hunt and "stop" 60 seconds later to end the hunt. The teacher may act as the timer.

6. Students begin the toothpick hunt.

7. Have the students bring the toothpicks they found into the class. The toothpicks can be placed in three piles according to color. Students can then count the toothpicks in each pile and record the numbers on the chart.

8. Discuss the results of the hunt with the students. They should find that the toothpicks that were closest to the color of the grass were hardest to find and the toothpicks with the greatest contrast were the easiest to find. The shape of the toothpicks may also have helped to conceal them.

9. Conclude the lesson by asking the students why they think golf balls are white (so that they can be seen in a grass environment). Ask the students why hunters often wear red clothing (so that they can be seen by other hunters).

DESIRED LEARNING OUTCOME: Ability to explain that color can hide objects.
****

INTRODUCTION: Lesson Cluster 1A-1 Protective Adaptations
Page T-24/S-3 Structures Have Functions (30-45 min.)

PURPOSE: Introduce concept that organisms have structures that have special functions.

ADVANCE PREPARATION: Materials - a chameleon*

*Have a chameleon as a permanent "pet" in the classroom. Use the identification card as a label.

Background Information - The adaptations described on pages 3-5 apply to the true chameleon, primarily of Africa. This is not the American "chameleon," or anole, of the western hemisphere, with which children may be familiar. These are about 80 species of true chameleons. This is why the pictured chameleons differ in appearances.

Language Cards/Key Signs
chameleon
structures
function

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to stare at a fixed spot in the front of the classroom. While they are staring at the spot, have them raise their hands to either side of their faces, so that their hands are within their peripheral vision. Tell them to move their hands apart slowly, until they can no longer see them. The distance between their hands, while their eyes are still staring at the front of the room, determines the limits of their fields of vision.

2. Ask the students what they think it might be like to be able to look in front of themselves and behind themselves at the same time. After a brief discussion, explain that they will be reading about an animal that can do just that.

3. Students look at the chameleon in the classroom. Help them to examine it carefully, making observations about the eyes, color, tongue (if possible), and tail.

4. Students read column 1 on page 3. Teacher may paraphrase.

5. Have the students read the remainder of the page and answer the questions.

6. Allow the students to share their responses as they work.

7. Discuss the lesson with the students when they have completed their work. Make sure the students understand that structures are special parts and functions are what the structures do.

DESIRED LEARNING OUTCOME: Ability to identify 3 structures of a chameleon and describe their functions.

****

INTRODUCTION: Lesson Cluster 1A-1 Protective Adaptations
Page T-26/S-4 Structures That Help (45-50 min.)

PURPOSE: Introduce the term adaptation and relate adaptations to structures and functions.

ADVANCE PREPARATION: Materials - a chameleon

Language Cards/Key Signs
chameleon
organism
environment
adaptation
function
structure

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson with a brief review of structures and functions by asking the students to name some chameleon structures and their functions (eyes that can move separately; skin that can change color and blend in with leaves and twigs; long, sticky tongue that can catch food.)

2. Introduce the term adaptation by using the language card.

3. Have the students read the first column on page 4 to find out the meaning of adaptation. Teacher may paraphrase text.

4. Students should examine the picture on page 4 and discuss the special structures they see the chameleon using.

5. Discuss the definition of adaptation with the students. Stress that adaptations help organisms stay alive.

6. Have the students read and do pages 4 and 5 to learn more about chameleon structures that are adaptations. Teacher may paraphrase.

7. Allow the students to discuss their responses with their neighbors as they work.

8. Move around the room providing help as needed.

9. Discuss the lesson with the students when they have completed their work. You may wish to draw a chart on the chalkboard with the headings Structure, Function, and Adaptation. Have a student name a chameleon structure and write it under the heading Structure. Have another student name the structure's function and write it under Function. Finally, have a third student tell whether the structure is an adaptation for food or protection and write it under the heading Adaptation. Students may discover that an adaptation can both protect a chameleon and help it get food. A chameleon's eyes and tongue, for example, can help a chameleon see and catch food. They can also help it to look around and eat without moving. This way animals that eat chameleons might not notice them.

10. Make sure the students understand that structural adaptations are not a conscious effort, but rather a result of the inherited traits the animal possesses.

DESIRED LEARNING OUTCOME: Ability to tell how chameleon structures are adaptations.

* * *

DEVELOPMENT: Lesson Cluster 1A-1 Protective Adaptations
Page T-28/S-6 Protective Color and Shape (40-45 min.)

PURPOSE: Develop the concept of protective adaptations by introducing animals that have protective color and shape.

ADVANCE PREPARATION: Materials - a chameleon.

Background Information - The animal adaptations dealt with in this lesson are divided into two kinds, camouflage and mimicry. All of the animals on page 6 are camouflaged as their colors blend into their environments. These animals on page 7 mimic, or resemble objects in their environments. These animals can easily be seen, but their mimicries allow them to be mistaken for other objects. Note that the word mimicry does not imply a conscious effort on the part of an organism. It is instead an inherited characteristic of which an organism may not be aware.

Language Cards/Key Signs
adaptation
color
shape
predators
protective

Identification Cards

TEACHING SUGGESTION:

1. Demonstrate the chameleon's ability to change color and blend into its background by placing it on a surface colored other than green. Brown is usually effective.

2. Discuss this adaptive behavior with the class asking how it helps the chameleon.

3. Introduce the lesson by asking the class whether they can think of any animals besides the chameleon that blend into their backgrounds and are hard to see. The fawn's dappled coat makes it hard to see against a forest background, and a chipmunk is almost impossible to see if it stand motionless at the base of a tree.

4. Students read the first paragraph on page 6. Teacher may paraphrase.

5. Introduce the term predators by using the language card. Have the students discuss its meaning. Check their understanding of the term by asking them to name the predator in each of the following situations: cat eating bird (cat); bird eating chameleon (bird); chameleon eating insect (chameleon).

6. Students complete reading page 6 and 7 and answer italicized questions. Teacher may paraphrase. These questions should be answered through discussions rather than in writing.

7. Students answer numbered questions 1, 2, and 3 either in writing or orally.

8. Discuss the numbered questions with the students when they have completed their work. Also discuss the differences between the adaptations on page 6 and those on page 7. You may want to include information from BACKGROUND INFORMATION in your discussion.

9. Make sure that the students understand that color and shape adaptations are not a conscious effort, but rather a result of the inherited traits the animal possesses.

DESIRED LEARNING OUTCOME: Ability to describe how color and shape of some organisms are adaptations.

****

DEVELOPMENT: Lesson Cluster 1A-1 Protective Adaptations
Page T-30/S-8 Defense Structures (30-35 min.)

PURPOSE: Further develop the concept of protective adaptations by introducing defense structures.

TEACHING SUGGESTIONS:

1. Introduce the lesson with a quick review of protective adaptations in animals, such as color and shape. Write these on the board or transparency.

2. Explain to the students that another kind of protective adaptation an animal might have is a defense structure. Introduce with the language card.

3. Students read the first paragraph on page 8. Teacher may paraphrase. Discuss when animals might use defense structures.

4. Students read the remainder of page 8 to find out how some animals defend themselves against predators.

Language Cards/Key Signs
defense structure
protective structure
predators
porcupine
quills
skunk

Identification Cards

5. Discuss the lesson with the students when they have finished.

6. Let the students share any experiences they may have had with skunks or porcupines. Ask a student who had a bad experience with a skunk or porcupine how they could avoid the same experience in the future. Explain that predators will often avoid the animals after one or more bad experiences.

7. Discuss the numbered questions with the students. Some students may think of, and wish to discuss, other examples of animals that have defense structures, such as rattlesnake with poisonous venom.

DESIRED LEARNING OUTCOME: Ability to describe animal adaptations used for defense.

****

DEVELOPMENT: Lesson Cluster 1A-1 Protective Adaptations
Page T-31/S-9 Protective Coverings (30-35 min.)

PURPOSE: Extend the concept of protective adaptations in animals to coverings that protect animals from environmental factors.

ADVANCE PREPARATION: Materials - a turtle.*
*Have a turtle on hand in the classroom in order to demonstrate the function of a protective shell. Label its habitat with an identification card.

Language Cards/Key Signs
protective covering
covering

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson by briefly reviewing protective adaptations that help animals hide from predators or that animals might use for defense. Write these on the board or transparency.

2. Let students examine the turtle. Discuss how the shell serves as its protection.

3. Students read the introduction to the lesson to find out about another kind of protective adaptation. Teacher may paraphrase.

4. Encourage the students to discuss different kinds of animal coverings.

5. Have the students read the remainder of page 9 and answer the italicized questions. Teacher may paraphrase the text and questions.

6. Allow the students to share their responses with their neighbors through discussion as they work. Written answers are not necessary.

7. Discuss the lesson with the students when they have finished their work. Stress that animals that live in different places might have different kinds of outside coverings.

8. Conclude the lesson with a discussion of the numbered questions. You may wish to extend the lesson by having the students collect and display pictures of animals with different outside coverings.

DESIRED LEARNING OUTCOME: Ability to identify protective coverings of animals as adaptations.

****

APPLICATION: Lesson Cluster 1A-1 Protective Adaptations
Page T-32/S-10 Plant Protection (40-45 min.)

PURPOSE: Apply the concept of protective adaptations to plants.

ADVANCE PREPARATION: Materials - plants that have protective coverings such as needles or thorns.*

*Label all plants with identification cards.

1. You may wish to take your class on a walk through a field where the students can observe various protective coverings.

Language Cards/Key Signs
protect
protective coverings

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing with the students animal protective adaptations, such as color, shape, defense structures, and protective coverings. Write these on the board or transparency.

2. Ask the students if they think that plants have protective adaptations. Allow the students to discuss the questions. Remind the students that most plants don't have structures that allow them to move quickly away from plant eaters or other environmental dangers.

3. Let students examine plants in the classroom or out of doors. Discuss their protective adaptations.

4. Students read page 10 and answer the italicized questions. Teacher may paraphrase text and questions.

5. Allow the students to share their responses through discussion. Answers need not be written.

DESIRED LEARNING OUTCOME: Ability to describe protective adaptations of plants.

* * *

APPLICATION: Lesson Cluster 1A-1 Protective Adaptations
Page T-33/S-11 Human Coverings (40-45 min.)

PURPOSE: To apply the concept of protective adaptations to human beings.

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to recall protective coverings in plants and animals (shells, skin, fur, feathers, needles, thorns). Write these on the board or transparency.

Language Cards/Key Signs
skin
fingernails
eyelashes
hair

Identification Cards

2. Ask each student to look at the hands and face of the nearest student in the class. Ask them if they notice any structures that might protect the person from dust, cold, or heat. Let the class discuss the question but allow the question to remain open-ended.

3. Have the students read the first paragraph on page 11 to find out about human coverings.

4. Have the students read the rest of page 11 and answer the questions. Teacher may paraphrase the text and questions. Answers need not be written.

5. Allow students to share answers through discussion.

6. Discuss the lesson with the students when they have completed their work. Discuss what other animals have instead of fingernails (see BACKGROUND INFORMATION). Ask the students how well they would be able to play or work if they had claws instead of fingernails. Let the class discuss what problems they might encounter if they had no eyelashes or eyelids.

DESIRED LEARNING OUTCOME: Ability to name some human outside coverings and describe how they are adaptations.

****

EVALUATION: Lesson Cluster 1A-1 Protective Adaptations
Page T-34/S-12 Finding Adaptations (40-45 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Listing outside structures that could help to protect organisms and describe how they are protective adaptations.
2. Describe an environment for which an organism's adaptations would be best suited.
3. Describe what makes a structure an adaptation.

ADVANCE PREPARATION: Materials - pencils and paper for each student.

TEACHING SUGGESTIONS:

1. Have the students turn to pages 12 and 13 and read through the lesson. Teacher may paraphrase text and questions.

2. Be certain that the students understand what they are to do. If necessary the teacher may explain each question as the students come to it.

3. Distribute paper and pencils and have the students do the lesson.

4. Go over the students' responses with them when they have completed their work. You may wish to let the students correct their own papers to enable them to evaluate their own progress.

5. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 1 Adaptations

Part A Outside Adaptations, Lesson Cluster 1A-2

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-40	Introduction	How An Octopus Eats	40-45 min.
T-42	Development	Kinds of Teeth	45 min.
T-43	Development	Insects Mouth Parts	35-40 min.
T-44	Development	How Animals Move	45 min.
T-45	Development	Movement Structures	35-40 min.
T-46	Application	Plant Structures	45 min.
T-48	Evaluation	Functions of Structures	40-45 min.

B. MATERIALS: Add the following items to the list on page T-37.
- pictures of octopi
- several slices of apples
- model of human and animal teeth
- pictures of animlas such as elephants, worms, camels, birds

FILMSTRIP INFORMATION: Filmstrip Set X, Structural Systems and XVII, Adaptations are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1A-2 Getting Food
Page T-40/S-14 How An Octopus Eats (40-45 min.)

PURPOSE: Introduce the concept that some outside structures are adaptations that help organisms get or eat food.

ADVANCE PREPARATION: Materials - pictures of octopi from sources other than the text.

Background Information - Octopuses (Octopi) live in many oceans. The largest examples of the creature have arms up to 4 meters (about 13 feet) in length. An octopus with its tentacles spread wide might achieve a diameter of about 9 meters (about 28 feet). Most octopi are, however, considerably smaller than this. Of the 50 or so known varieties, most kinds grow no larger than the size of a volleyball.

Language Cards/Key Signs
octopus
protection
protective structures
predators
prey
suckers

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students if they have ever seen an octopus. They may have in an aquarium or zoo. If someone has, ask that student to tell the class how large it was. It is important that the class not get the idea that all octopi are huge animals. (See BACKGROUND INFORMATION.) The pictured octopus is quite small. Students should examine the pictures in the text and from other sources.

2. While examing the pictures encourage the students to describe the octopus. On the board make notes of their observations concerning size, color, number arms, their appearance, and any other features mentioned.

3. Students read the first three paragraphs on page 14. Teacher may paraphrase.

4. Discuss the meaning of prey with them. Ask the students to name the predator and the prey in the following situations: a chameleon (predator) eats an insect (prey); a bird (predator) eats a chameleon (prey); and a snake (predator) eats a frog (prey). It may be helpful to record this information on the board in chart form. More familiar examples may be included, i.e. cat eats mouse, bird eats worms, etc.

5. Students continue to read pages 14 and 15. Teacher may paraphrase. Let the students respond to the questions in a discussion. Written responses are optional.

6. You may wish to tell the students that the balloon-like structure that helps an octopus move is called a siphon (or funnel). Demonstrate the quick movement of an octopus through water by releasing an inflated balloon in the air. This should aid the students' understanding of the description on page 15.

7. Discuss the numbered questions with the students. Point out that the octopus's beak is located in the midst of the eight tentacles and is very small. It is retracted when the animal is not feeding.

DESIRED LEARNING OUTCOME: Ability to name and describe outside adaptations that help an octopus get or eat food.

* * *

DEVELOPMENT: Lesson Cluster 1A-1 Getting Food
Page T-42/S-16 Kinds of Teeth (45 min.)

PURPOSE: Develop concept that certain structures help animals to eat food.

ADVANCE PREPARATION: Materials - a piece of apple for each student, a model of human teeth and animal teeth.

Language Cards/Key Signs
teeth
structure
adaptation
predator
wide and flat teeth
sharp and pointed teeth

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students feel the surfaces of their teeth with their tongues and by examining a model of human and animal teeth. Ask them how the teeth they feel differ in size and shape. Ask the students to speculate on the functions of the different kinds of teeth. Allow this question to be open-ended.

2. Students read page 16 up to the numbered questions. Teacher may paraphrase.

3. Students may respond to italicized questions in discussion. Written answers are optional.

4. Discuss the lesson with the students. Ask the students why the arrangement of sharp teeth in the front and flat teeth toward the back of the human mouth is important. Students should try to eat an apple or other crisp food entirely with the sharp front teeth. Discuss the results with the class.

5. Discuss the numbered questions with the students. Generally, the students should draw the conclusion that plant eaters use broad flat teeth to grind and chew and meat eaters use sharp pointed teeth to pierce and tear. Humans, who are both plant and meat eaters, have a combination of both kinds of teeth. You may wish to discuss the importance of claws in helping to catch food.

DESIRED LEARNING OUTCOME: Ability to identify teeth as an adaptation for chewing food and describe the connection between type of food and shape of teeth.

****

DEVELOPMENT: Lesson Cluster 1A-2 Getting Food
Page T-43/S-17 Insect Mouth Parts (35-40 min.)

PURPOSE: To further the concept that certain structures help animals eat their food.

ADVANCE PREPARATION: Materials - manifying glass, insect specimen*

*Such as ants, moths, grasshoppers, etc. Label each insect with an identification card.

Background Information - The students might find it interesting to learn that only the female mosquito bites. Females of some species have to sip blood before they can lay eggs that will hatch. Each species of female prefers the blood of a different type of animal. Some prefer cold-blooded animals such as frogs and snakes, others prefer birds, while some will bite only horses, cows, or people.

Language Cards/Key Signs
mouth parts
insect
Harvester ants
mosquito
butterflies

Identification Cards
(label for insects)

TEACHING SUGGESTIONS:

1. Introduce the lesson by having the students share their experiences with insect bites.

2. Ask the students what structures might help insects eat food. For instance, do they have teeth like people, or jaws like octopi? Allow students sufficient time to offer their opinions. Explain that in this lesson they will be learning about insect mouth parts.

3. Guide students in an examination of insect specimen with a magnifying glass. Help them to pay particular attention to the mouth area of each insect, observing the similarities and differences among them. Students may draw sketches of the insects' mouth parts.

4. Students read page 17 and answer questions during discussion. Written answers are optional. Encourage students to explain why the mouth parts of each insect are adaptions.

DESIRED LEARNING OUTCOME: Ability to identify insect mouth parts as structures that help them eat their particular foods.

****

DEVELOPMENT: Lesson Cluster 1A-2 Getting Food
Page T-44/S-18 How Animals Move (45 min.)

PURPOSE: Develop the concept that structures that allow movement help animals get their food.

ADVANCE PREPARATION: Materials - a variety of animals in classroom habitats*,
crayons
reference books dealing with classroom animals

*The chameleon and turtle used in previous lessons should be useful. In addition, toads, rabbits, fish, snakes, etc. may be used. Make sure each animal is in its proper home such as a cage, aquarium or terrarium with food and water. Label each animal with an identification card.

Language Cards/Key Signs
environment
structure

Identification Cards
chameleon
turtle

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing with the students how an octopus moves (water is shot out of balloon-like structure). Explain to the students that in this lesson they will be learning about structures that other animals have that help them move.

2. Have the students read the lesson page 18 to find out what they are to do. Teacher may paraphrase.

3. Discuss the directions for the activity with the students. You may wish to divide the students into small groups for observing and drawing the animals.

4. Show the students the location of the animals. Stress that they should take care not to frighten or touch the animals while observing them.

5. Distribute the materials and have the students do the activities.

6. Let the students share their drawings and research with the class when they have completed their work. You may want to have the students display their work on a bulletin board.

7. Discuss the numbered questions with the students. You may wish to also discuss structures that help animals stay in one place, such as a chameleon's tail, suction cups on a tree toad's feet, and feet that allow some insects to "stand" on the ceiling.

DESIRED LEARNING OUTCOME: Ability to identify movement structures of certain animals and describe how these structures help the animals get food.

****

DEVELOPMENT: Lesson Cluster 1A-2 Getting Food
Page T-45/S-19 Movement Structures (35-40 min.)

PURPOSE: Develop the concept that structures that allow movement help animals get their food.

ADVANCE PREPARATION: Materials - pictures of animals such as elephants, worms, camels, birds, etc.

Language Cards/Key Signs
outside adaptations
movement
structures
monkeys
seals
flamingos
environment

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing with the students how an octopus moves. (Water is shot out of balloon-like structure.) Explain to the students that in this lesson they will be learning about structures that other animals have that help them move.
2. Have students examine pictures on page 19 and comment on how they think each animal moves. This is an open ended discussion with no "correct" answer required.
3. Students read page 19 up to numbered questions. Teacher may paraphrase.
4. Discuss the questions with the students when they have finished their work. While showing the students pictures of animals, you may want to discuss the movement structures of other animals such as giraffes, camels, earthworms, and elephants.
5. Ask the students if they can think of a structure that could help an animal stay in one place instead of move (examples are a chameleon's tail, suction cups on tree toad's feet, and feet that allow some insects to "stand" on ceilings).

DESIRED LEARNING OUTCOME: Ability to identify movement structures of certain animals and describe how those structures help the animals get food.

* * *

APPLICATION: Lesson Cluster 1A-2 Getting Food
Page T-46/S-20 Plant Structures (45 min.)

PURPOSE: Apply the concept of outside adaptations to plants.

ADVANCE PREPARATION: Materials - none.

Background Information - Green plants manufacture their own food in their leaves by a process called photosynthesis. Photosynthesis combines water and carbon dioxide in the presence of chlorophyll (green matter that gives the plant its coloration) and sunlight. Plants that are not green (such as mushrooms and other fungi) cannot make their own food, and so must live on other organic matter (living or dead, plant or animal).

Language Cards/Key Signs
plants
roots
vines
seaweed
stem
lily pad
tubes
plant structures

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the class whether animals are the only living things that need food. Students should realize that anything that is alive must have food if it is to go on living.

2. Students read the first column on page 20. Teacher may paraphrase.

3. Discuss with the students how green plants get food. Make sure that they understand that the roots do not get food. Instead, they get water and other materials that will be changed into food in the plants' leaves.

4. Students complete reading page 20 and 21. Teacher may paraphrase.

5. Questions may be answered through class discussion. Written responses are optional.

6. Ask the students if they think it would help a vine to have air pockets in its leaves. Emphasize that a structure is an adaptation only if it helps an organism stay alive in its environment.

7. Extend the lesson, if you wish, by taking the students outside the school to observe plants. Ask them to find plants with structures that help get sunlight, water, and other materials to make food. Ask them to find structures that have other functions, such as support or protection.

DESIRED LEARNING OUTCOME: Ability to identify plant structures and describe how they are adaptations.

****

EVALUATION: Lesson Cluster 1A-2 Getting Food
Page T-48/S-22 Functions of Structures (40-45 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Identifying teeth that belong to a plant eater and to a predator.
2. Matching mouth parts to their functions.
3. Describing how an animal can move, naming its movement structures, and explaining how the structures help an animal in its environment.
4. Describing how plant structures are adaptations.

ADVANCE PREPARATION: Materials - paper and pencils.

TEACHING SUGGESTIONS:

1. Have the students turn to pages 22 and 23 and read through the lesson. Teacher may paraphrase.

2. Have the students proceed with the lesson when you are certain that they understand what they are to do.

3. Go over the responses with the students when they have completed their work.

4. Let the students correct their own papers, if you wish.

5. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

6. For further informal evaluation, have the students turn back to page 2 and look at the picture that introduces Part A. Ask them why they think that particular picture was used to introduce the part that they have just completed. Suggest that they look for clues in the part title, and in the cluster titles on pages 3 and 14. The students should be able to:

   a. identify a giraffe neck as an adaptation that helps the giraffe get food.
   b. identify giraffe legs as an adaptation that helps the giraffe move.
   c. describe the giraffe tongue as a structure that helps the giraffe get and chew food.
   d. identify coloration as a protective adaptation.
   e. describe environments in which giraffe structures would not be adaptations.

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Level 5 Unit 1 Adaptations

Part B Inside Adaptations, Lesson Cluster 1B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-56	Introduction	On The Inside	20-35 min.
T-57	Development	A Chicken Skeleton	40-50 min.
T-60	Development	Respiratory Systems	40-50 min.
T-62	Development	Digestive Systems	40-45 min.
T-64	Development	A Muscular System	*See note below
T-65	Application	Systems Interact In the Hands	40-45 min.
T-66	Evaluation	Systems Have Parts	40-45 min.

*This lesson has been extended into a 2 to 3 day lesson.

NOTE: Skeletal Systems, T-58 has been eliminated.

B. MATERIALS - See Advance Preparation on page T-57. Add the following materials to the list on page T-53:

- dittos of human body - Model provided in this cluster
- large sheet of paper (5' x 2')
- set of cut out models of inside structures - Models provided in this cluster
- several magic markers or crayons
- glue or paste
- picture showing internal anatomy of humans and other animals
- * - preserved internal organs of animals
- dittos of fish, cat and grasshopper (unlabeled) on from page 28- 29
- live fish and grasshopper and/or cricket
- dittos of pictures A, B, and C on p. 30 and 31 (unlabeled)
- * - model of human skeletal system
- paper punch

Each child will need:
- 2 8" lengths of string
- a 8½" x 14" piece of mimeograph paper
- 2 12" rulers
- a 8½" x 11" piece of construction paper

*Optional

FILMSTRIP INFORMATION: Filmstrip Set X, Structural Systems, and XVII, Adaptations are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1B-1 Systems
Page T-56/S-25 On The Inside (20-35 min.)

PURPOSE: Introduce the concept that organisms may have several inside systems with different functions that help it stay alive.

Language Cards/Key Signs
inside structure
system
skeleton
stomach
lungs
heart
interact
leg bone
brain
intestines

Identification Cards
(labels for preserved organs if used)

ADVANCE PREPARATION: Materials - One of the following for each child:
- ditto of the human body showing the following inside structures: stomach, heart, lungs, leg bones, brain, intestines. This ditto can be made by copying the diagram provided with this lesson.
- large sheet of paper (5' x 2'). Blank newsprint or wrapping paper would be ideal.
- 1 set of cut out models of inside structures. Models are provided with this lesson.
- scissors
- glue or paste
- several magic markers, crayons, pencils
- Picture showing the internal anatomy of people and other animals.
- *- preserved heart, lungs, and any other internal organs that you can get from a slaughter house or other source.

*This material is optional.

TEACHING SUGGESTIONS:

1. Begin the lesson by asking the students to name outside structures of organisms that they have studied. Refer to pictures and examples used in previous cluster. Responses may include any observable structures, such as skin, fur, eyes, legs, leaves, roots, and mouth parts. Explain to the students that in this part they will be learning about inside structures.

2. Introduce the term inside structures with the language card and ask the students to what inside structures may refer. Accept all opinions.

3. Show the class pictures of the inside structures of humans and other animals. Point out the heart, lungs, stomach and intestines.

4. Have students read the introduction to the lesson on page 25 or teacher may paraphrase. Use the pictures already shown to reinforce the information.

5. If possible show the students samples of preserved inside structures. Label each with an identification card and display in the room for some period of time.

6. Distribute dittos of the human body and have students label the inside structures.

7. Distribute large sheets of paper and divide students into pairs. While one child lies on the paper the other should trace his or her outline. When complete they may change roles. When outlines are complete students should cut them out.

8. Give each child a set of internal structures that have been cut out. If preferred the students may cut out the structures.

9. Have the students label each structure and paste them in the appropriate location on their own body outline. The finished products can be displayed around the room or in one area labeled Inside Structures.

10. Explain to the students that these structures work together or interact, and when they do so they are called a system. Introduce the terms interact and system with the language cards.

11. Have students read the remainder of page 25 or teacher may paraphrase.

12. Students should answer questions either in writing or through class discussion.

13. Discuss the lesson with the students when they have completed their work.

DESIRED LEARNING OUTCOME: Ability to name inside structures that interact in a system.

****

DEVELOPMENT: Lesson Cluster 1B-1a Systems
Page T-57/S-26 A Chicken Skeleton (40-50 min.)

PURPOSE: Develop the concept of inside structural systems by introducing a skeletal system.

ADVANCE PREPARATION: Materials
- 2 pieces wire (#18 to #24) 20 cm (8 in.) in length
- 2 chicken or turkey skeletons - see Advance Preparation page T-57
- paper towels
- pictures or models of human and other animal skeletons. Pictures on page 27 may be used.

Language Cards/Key Signs
skeleton
skeletal system
bones
joint

Identification Cards
label for chicken or turkey
(skeleton put on display)
labels for neck, legs, wings and ribs

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to turn to page 26 and view the picture. Explain that it is the skeleton or the bones of an animal. Use the language card to introduce these terms. Ask the students if they can infer from the pictured skeleton the animal to which the skeleton belongs (fowl). Encourage the students to explain why they think it's a particular skeleton.

2. Have students read introductory paragraph. Teacher may paraphrase.

3. Divide the students into two groups.

4. Discuss the directions found on page 26 with the students.

5. Let each group go to an area where there is a tray of bones from one skeleton and do the activity. You may wish to have the students lay out the bones of only one skeletal part such as a wing, a leg, or the neck.

6. After the students have identified the leg, wing, neck bones, and ribs and wire the neck, discuss the italicized questions with the class.

7. Introduce the term joint and identify joints in the skeleton. Discuss their function.

8. Wrap a paper towel around a leg bone from each skeleton and break the bone in half. Ask the students to describe the inside of the bone.

9. Have the students draw a picture of a chicken or turkey skeleton, which ever is used in class, and label the leg, wings, neck, ribs, and a joint.

10. Discuss the numbered questions with the students. Use pictures or models of skeletons of humans and other animals to stimulate discussion.

11. When lesson is completed, put the skeleton on display with identification cards describing it.

DESIRED LEARNING OUTCOME: Ability to relate chicken bones to their functions and identify a joint.

****

DEVELOPMENT: Lesson Cluster 1B-1 Systems
Page T-60/S-28 Respiratory Systems (40-50 min.)

PURPOSE: Develop the concept of inside systems by introducing different respiratory systems and their parts.

ADVANCE PREPARATION: Materials - One of the following for each child:
- ditto of a fish showing a gill
- ditto of a cat showing the nose, air tube and lungs
- ditto of a grasshopper showing air tubes and air holes.

These dittos may be copies of the diagrams on page 28 and 29 but without the labels filled in. Live fish in a fish bowl or aquarium. This may become a permanent part of the classroom.

- live grasshopper and/or cricket

Language Cards/Key Signs
respiratory system
oxygen
breathe
gills
lungs
air holes
air tube

Identification Cards
(labels for worm and insects)

TEACHING SUGGESTIONS:

1. Begin by asking the class to watch you as you demonstrate breathing. Exaggerate so that what you are doing will be obvious to the class.
2. Ask the students what you are doing (breathing) and what they think would happen if you stopped breathing for along time, i.e. maybe 15 minutes.
3. Explain to the students that they are going to learn about an inside system that helps people and animals "breathe."
4. Introduce the term respiratory system with the language card. Explain that the lungs, a part of the respiratory system, help people and some animals to breathe.
5. Let the students identify the lungs in picture B on page 28 and on the diagrams and forms they made in a previous class.
6. Explain that some animals do not have lungs. Instead other structures help them "breathe" or get oxygen from the environment.
7. Use the fish as an example. Ask students to examine picture A on page 28 and see if they can find lungs in the fish. Instead of lungs, what do they think fish have? Can they "guess" from the picture?
8. Explain that now you will read and talk about what the respiratory system is and how it works in animals like fish and cats.
9. Students read page 28 and the first paragraph on page 29. Teacher may paraphrase. Use a line fish to illustrate the gills working as well as picture A. Discuss italicized questions.
10. Distribute dittos of the fish and cat and have students label the parts shown.
11. Have the students look at the insects (grasshopper, cricket) that you have brought to class. Discuss with them how the insects look and how they "breathe" or get oxygen from the air. Do the insects have gills or lungs? Encourage the students to explore and use their imaginations. All responses are acceptable.
12. After this exploration, the students read the second paragraph on page 29 or the teacher may paraphrase. Use live examples for illustration. Compare the students' original ideas with how the insects really get oxygen from the air.
13. Discuss the italicized questions.
14. Have students label the ditto showing the grasshopper.
15. Explain to the students that people, cats and grasshoppers are air breathers. Fish are not. Explain that air breathers drown under water because lungs cannot separate oxygen from water, as gills can.
16. Let students examine an earthworm, speculating on how it gets oxygen. Does the earthworm have gills, lungs or holes?
17. Have students read the last paragraph on page 29. Teacher may paraphrase. Encourage them to compare their original ideas with what they have read.

18. Explain to the students that because an earthworm has a small body the skin provides enough surface area for absorption of oxygen into the bloodstream. Therefore, an earthworm does not require an actual respiratory system.

19. Have students answer the numbered questions in writing or through discussion.

20. Explain to the students that in polluted water there is usually little oxygen. Ask the students why a fish might have trouble living in polluted water (does not get enough oxygen).

DESIRED LEARNING OUTCOME: Ability to describe and compare 3 different kinds of respiratory systems.

* * *

DEVELOPMENT: Lesson Cluster 1B-1 Systems
Page T-62/S-30 Digestive System (40-45 min.)

PURPOSE: Develop the concept of inside systems by introducing different systems and their parts.

ADVANCE PREPARATION: Materials - One of the following for each student:
- ditto of pictures A, B and C on page 30 and 31 in text. Do not include the labels on the dittos.

Language Cards/Key Signs
digestion
digestive system
food tube
intestines
anus
crop
gizzard
stomach
cud

Identification Cards

TEACHING SUGGESTIONS:

1. Begin by explaining to the students that another inside system helps people and other animals to stay alive.

2. Students read the first 2 paragraphs on page 30. Teacher may paraphrase.

3. Introduce the terms digestive system and digestion with the language cards.

4. Have the students read the remainder of the column. Introduce new terms with language cards.

5. Remind the students of the different types of teeth discussed in Cluster A-2: the wide flat teeth of plant eaters and the sharp pointed teeth of predators.

6. Discuss with the students how food travels from the mouth to the blood. Explain that the food pieces become so small that they move through the walls of the intestine and blood tubes.

7. Have students fill in the ditto of the digestive system of the dog.

8. Explain to the students that not all animals have the same kind of digestive system. Compare pictures A and B and ask how they are different and the same.

9. Have the students read the second column on page 30 and study picture B to find out about a chicken's digestive system. Teacher may paraphrase the text.

10. Introduce new terms with the language cards. Discuss italicized questions.

11. Discuss the digestive system with the students. Explain that sometimes birds swallow pebbles and sand. While in the gizzard they aid in grinding food. Students that have a pet bird may be familiar with gravel that can be added to a bird's food. Note that a chicken has an opening (cloaca) rather than an anus.

12. Have the students fill in the ditto of the digestive system of the chicken.

13. By looking at picture C ask the students to compare the digestive system of the cow to the chicken's.

14. Students read column one on page 31 or teacher may paraphrase the text. Introduce new terms with the language cards.

15. Discuss italicized questions.

16. Through discussion or in written form have the students answer the numbered questions.

DESIRED LEARNING OUTCOME: Ability to describe the function of a digestive system and compare the digestive systems of a dog, chicken and cow.

****

DEVELOPMENT: Lesson Cluster 1B-1 Systems
Page T-64/S-32 A Muscular System (2 to 3 days)

PURPOSE: To further the concept of inside systems by introducing a muscular system.

ADVANCE PREPARATION: Materials
- 2 rolls of masking tape
- 1 paper punch
- Each child should have:
  - 2 8" lengths of string
  - 2 12" rulers
  - 1 scissors
  - 8½" x 11" piece of construction paper
  - 1 rubber band
  - 8½" x 14 " memeograph paper

Language Cards/Key Signs
muscular system
muscles
relax
contracts
biceps

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students read the introduction to the lesson on page 32.

2. Introduce the words contract and relax with the language cards.

3. Demonstrate the arm muscles contracting and relaxing by doing the activity described on page 32. In addition to activity have students examine pictures A and B.

4. Teacher should paraphrase the remainder of the text on page 32.

5. Make sure that the students understand that movement is caused by muscle pulling on a bone. You might have students try to move objects with a rubber band, holding one end only. They will discover that they can move objects only by pulling not pushing the rubber band. Explain to the students that muscles can move bones only as far as the joint allows.

6. Ask the students what might happen if both ends of one muscle were attached to one bone. Have them explain why the muscle could not move the bone.

7. Explain to the students that the muscles pictures on page 32 are muscles that they can make work. There are other muscles that are not under their control. You may wish to discuss some of these involuntary muscles with the students. A heart, for example, is a muscle not attached to a bone that works automatically. It pumps blood by contracting. Students can squeeze an empty squeeze bottle to understand how the beating heart pumps. A food tube contains involuntary muscles that help push food to the stomach automatically.

8. In order to more thoroughly demonstrate how muscles work the students can make a working model of the biceps muscle.

9. For demonstration the teacher should fold the 8½" x 14" mimeograph paper as shown in Diagram 1. The paper will appear fan-like. Fold the paper lengthwise in halves, then quarters, and finally eighths to establish the fold lines. Then reverse the folds as needed to produce an accordian-like model. Be sure the outside folds are in the same direction.

10. Give each pair of students a sheet of paper, two 3-inch pieces of tape, and two pieces of string. Instruct the students in taping the ends of the folded paper with masking tape or cloth tape. See Diagram 1. Hold up your taped model, and tell the students:

    When your muscle model is taped like this, bring it to me and I will punch holes in each end.

11. After the holes are punched in each end of the models the teacher should tell the students to place the strings they were given through the holes punched in the ends of their muscle model. Tie the ends of the string together so that they have loops like the model.

12. Teacher holds up the completed model, and says:

    Just like a real muscle, this model must be used carefully, so as not to tear it. See if you can discover how it works.

13. When a student is observed pulling the sides of the model in and out, working the model like an accordian, have him demonstrate how it works to the class. Encourage students to work the muscle model several times.

    Note: Models will work better with repeated use.

14. Place the model on the desk, and demonstrate as shown in Diagram 2. Ask the students to work their models in a similar way. Ask the students: What happens to the length of the muscle model when you spread it out? How can you tell? or,

    Show me how you can tell it is shorter?

    Now we know that the muscle model got shorter. What else happend to it as you pulled out the sides? What two things would a muscle do when it works?

15. Teacher should hold up your model in the contracted (short, fat) condition, and say:
    Show me what position your arm would be in when your biceps muscle is like this.

    Now put your model in the relaxed (long, narrow) condition by pulling on the ends.
    Show me what position your arm would be in when your biceps muscle is like this.

16. Now call on each pair of students to demonstrate the two states of the biceps. Have them use their muscle models and arms in appropriate positions.

17. Instruct the students to:
    a. Feel again what happens to your arm muscles when you raise your hand from the desk top.
    b. Place your model on the top of your leg as you sit in your chair. Now use the model to show me how your thigh muscle might act to move your lower leg.

THIS IS A GOOD PLACE TO BREAK. SAVE THE MUSCLE MODELS FOR THE NEXT DAY'S ACTIVITY.

1. The continuation of the previous activity includes the construction of an arm model that will illustrate muscle function and attachment, their relationship to bones, and the function of joints.

2. Prior to starting this activity, construct your own model of the arm as shown in Diagram 3. Be sure you are familiar with how it functions. Do not display it, however, for in this activity the students will attempt to design and construct their own models. Student-made models may be as good as yours. If one student model functions properly you will not need to use your model at all!

3. Teacher should ask the students how they can tell one end of their arm from the other?

4. Now tell the students to cut out a paper model of one of your hands. Have students trace a hand on the sheet of paper provided, and cut out around the outline.

5. Teacher then asks:
    What can you feel in your arm besides muscles?
    How many "bones" do you think you would need to make a model of the arm to go with the paper hand?

6. Let's find out how many you would need. See if you can make a model of your arm. Work in the same pairs you did to make the muscle model.

7. Place the 1" x 1/8" x 12" sticks and masking or cloth tape on a table. Tell students to use their muscle models, hand outlines, and whatever else they need from the supply table to make a working arm model.

8. Teacher should keep previously constructed, functioning arm model out of sight.

9. Student models may vary in many ways, but students will probably discover that:
    1. Two "bones" (sticks) are required.
    2. A joint is needed.
    3. Taping the "muscle" to the "bones" is required.
    4. Proper positioning of the "muscle" is necessary for the "arm" to function as a real arm.

Encourage students to study how their own arms work as they make their models.

10. When most students have finished, discuss each model. Have one student in each pair demonstrate how their model works. Have him point out similarities to the real arm. Ask students to tell about any problems they have have had.

Now bring out your model and have students compare their models with yours. Some of the student models will be very functional. Your model can be used to reinforce their good work. Other models will be less functional. These less functional models can serve as a basis for a good discussion of why an arm built like their model would not work very well.

Application - Extension

After completing the arm model the design can be utilized in constructing legs.

For reinforcement, ask the students to use similar principles and constract a working leg model. This activity serves as a check to see if the principles have transferred sufficiently from the models to their bodies.

DESIRED LEARNING OUTCOME: Ability to describe how muscles move parts of the body.
****

Diagram 1

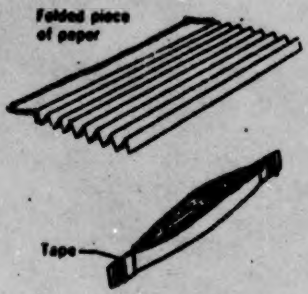


Diagram 2

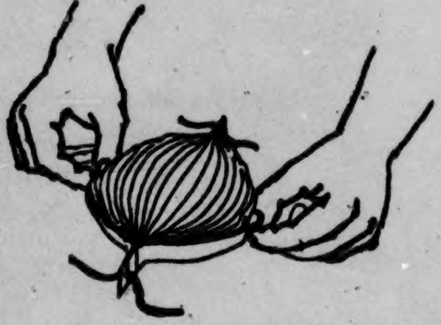
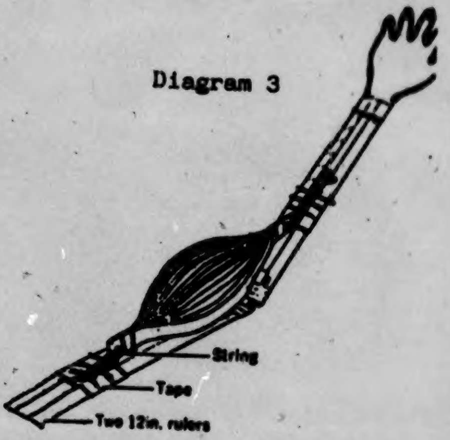


Diagram 3



APPLICATION: Lesson Cluster 1B-1 Systems
PageT-65/S-33 Systems Interact in the Hands (40-45 min.)

PURPOSE: Apply the concept of the skeletal and muscular systems to the human hand.

ADVANCE PREPARATION: Materials
- If possible, a model of the human skeletal system, otherwise a picture may be used.
- several (8-10) peanuts in the shells for each student
- a nut and bolt for each student
- a roll of tape

Language Cards/Key Signs
skeletal system
bones
thumb
interact
muscular system

Identification Cards
skeletal system

TEACHING SUGGESTIONS:

1. Using a model or picture of the human skeletal system, have students examine it. Ask them what they think it is. Introduce the term skeletal system, explaining that it is made up of many bones that work together or interact.

2. Have the students read the first paragraph on page 33. Teacher may paraphrase.

3. Discuss the paragraph with the students. You may wish to review how each end of a muscle is attached to a different bone and how the contraction of a muscle makes bones move.

4. Have the students examine the x-ray picture of the bones in a person's hand. Ask them what part of the body it is. Can they find it on the model or in the picture of the skeleton used earlier? Can they identify the thumb? Why do they think the thumb is such an important adaptation? Use this question for stimulating thinking and discussion. At this point it is not important that they know the answer.

5. Have students compare their hand to a dog's paw. Can people do things with their hands that dogs cannot do with their paws?

6. Explain to the students that they will try to do an activity without using their thumbs.

7. Explain the directions for the activities.

8. Discuss the directions with the students making sure they understand what they are to do.

9. Divide the class into groups of two and distribute the materials.

10. Have the students begin the activity. Make sure that the students' thumbs are taped as in the photograph on page 33. The tip of the thumb must be taped so it is immovable. Another manipulative activity would be to have students try to screw a nut onto a bolt with their thumbs taped and then untaped.

11. Discuss the activity with the students. Include the italicized questions in the discussion. Ask them what an animal with paws might use to break peanuts (probably mouth parts).

12. Have the students help you clean up the broken shells. They can eat the peanuts if you wish.

13. Have the students respond to and discuss the numbered questions. In discussing the last question, ask the students if they can think of any disadvantages of walking on two legs. Because of the body weight being supported by two feet rather than four, people sometimes have sore feet and fallen arches. The horizontal back of a four-legged animal better supports weight. People often complain of backaches because most of the weight of the upper half of the body rests on disks between the back bones.

DESIRED LEARNING OUTCOME: Students should describe how the thumb is an adaptation.
****

EVALUATION: Lesson Cluster 1B-1 Systems
Page T-66/S-34 Systems Have Parts (40-45 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Describing how to tell if certain structures make up a system.
2. Identifying an animal by its skeletal system.
3. Describing how various systems interact and how they are adaptations.
4. Matching systems to their names and naming one function for each system.

TEACHING SUGGESTIONS:

1. Have the students turn to pages 34 and 35 and read through the lesson. Teacher may paraphrase the text and questions. Rewrite the questions on the board if necessary.

2. Have the students proceed with the lesson when you are certain that they understand what they are to do. Encourage the students to look at the pictures carefully.

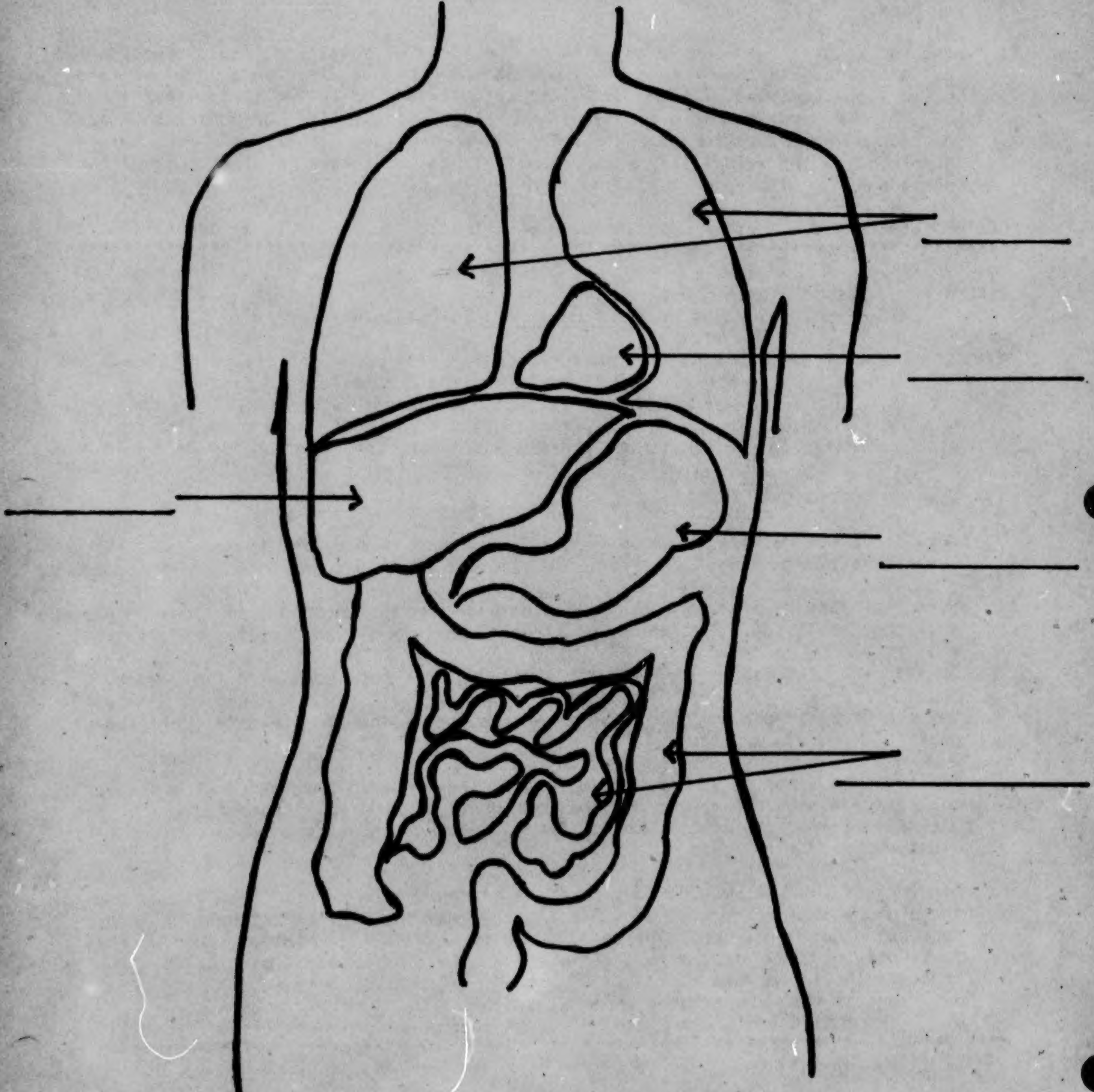
3. Go over the students' responses with them when they have completed their work.

4. Let the students correct their own papers to enable them to evaluate their own progress, if you wish.

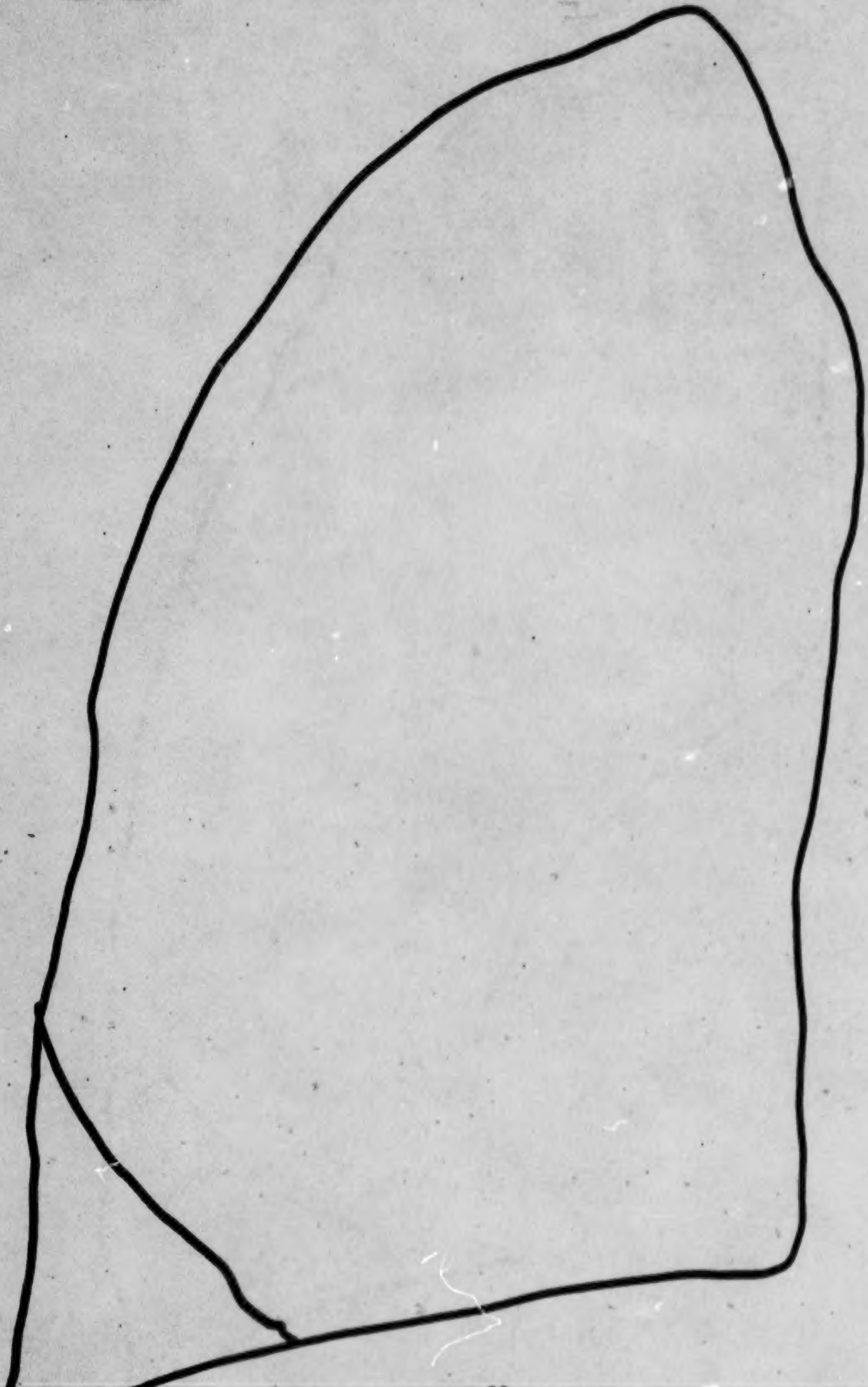
5. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to all or most of each question, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

6. For further informal evaluation, have the students turn back to page 24 and look at the picture that introduces Part B. Ask them why they think that particular picture was used to introduce the part that they have just completed. Suggest that they look for clues in the part title and in the cluster title on page 25. The students should be able to:
   a. identify snake bones as a skeletal system.
   b. infer that a snake's skeleton gives it shape, and protects its soft parts.
****

INTERNAL STRUCTURES OF THE BODY

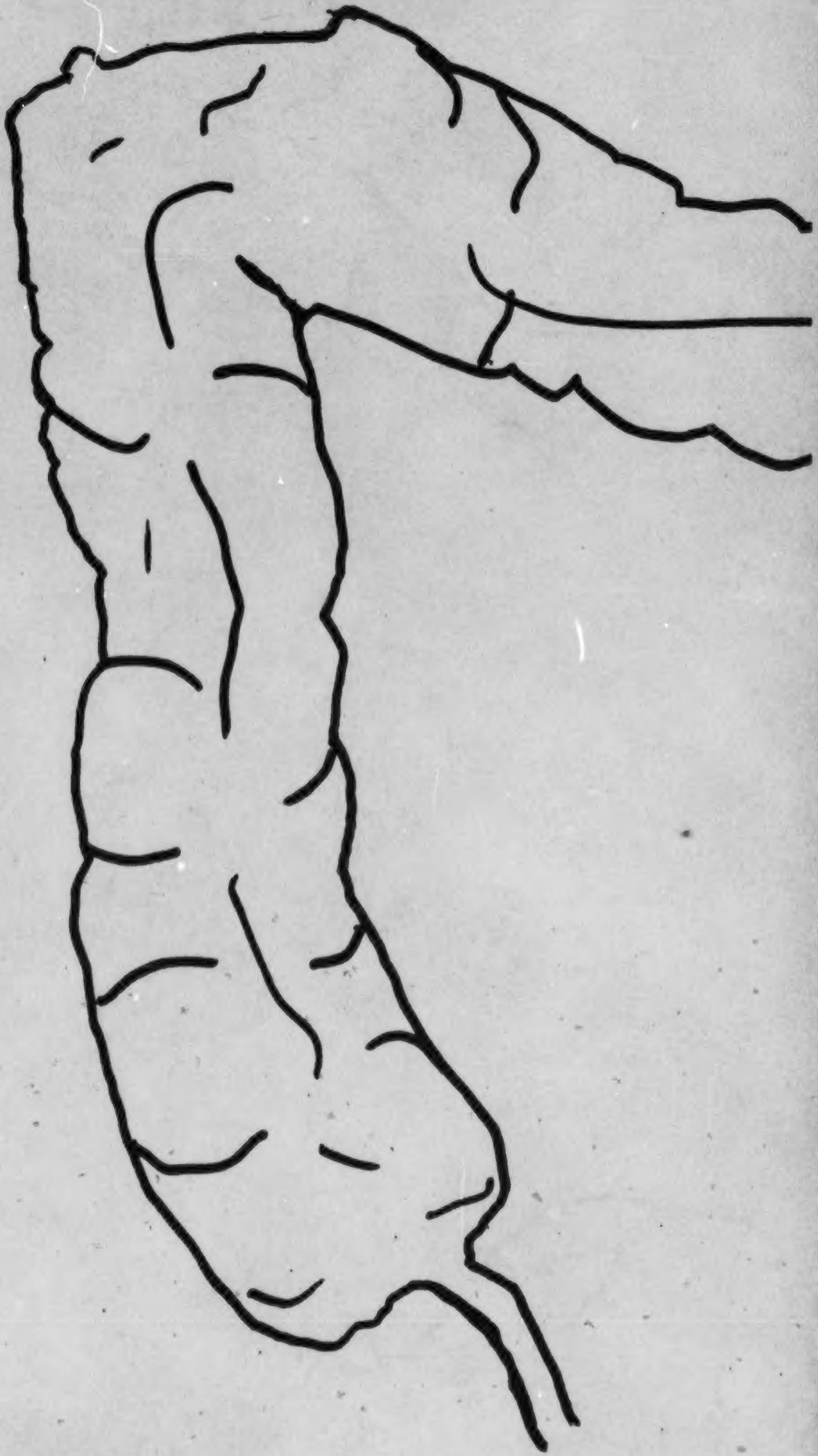


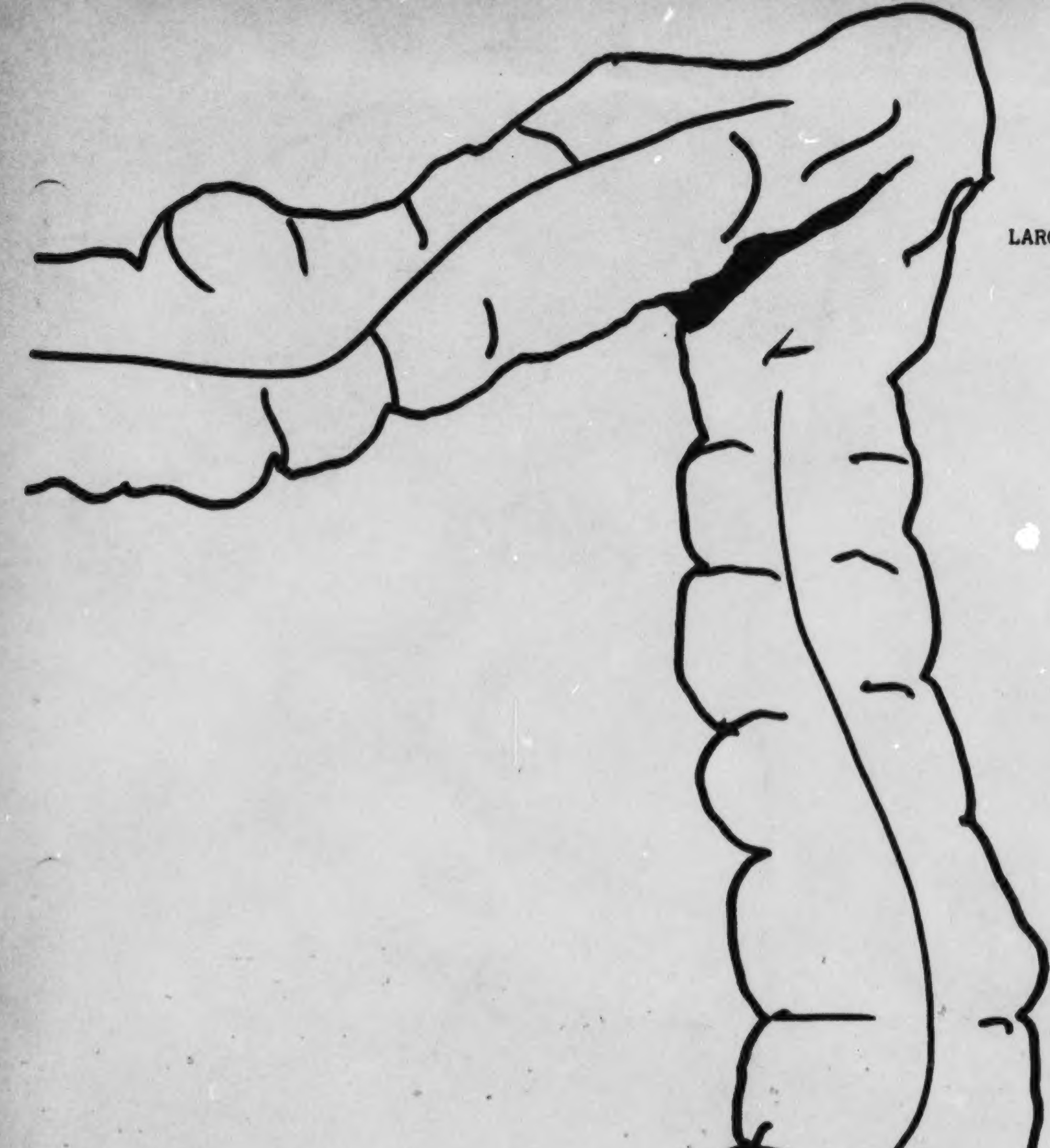
LEFT LUNG



RIGHT LUNG

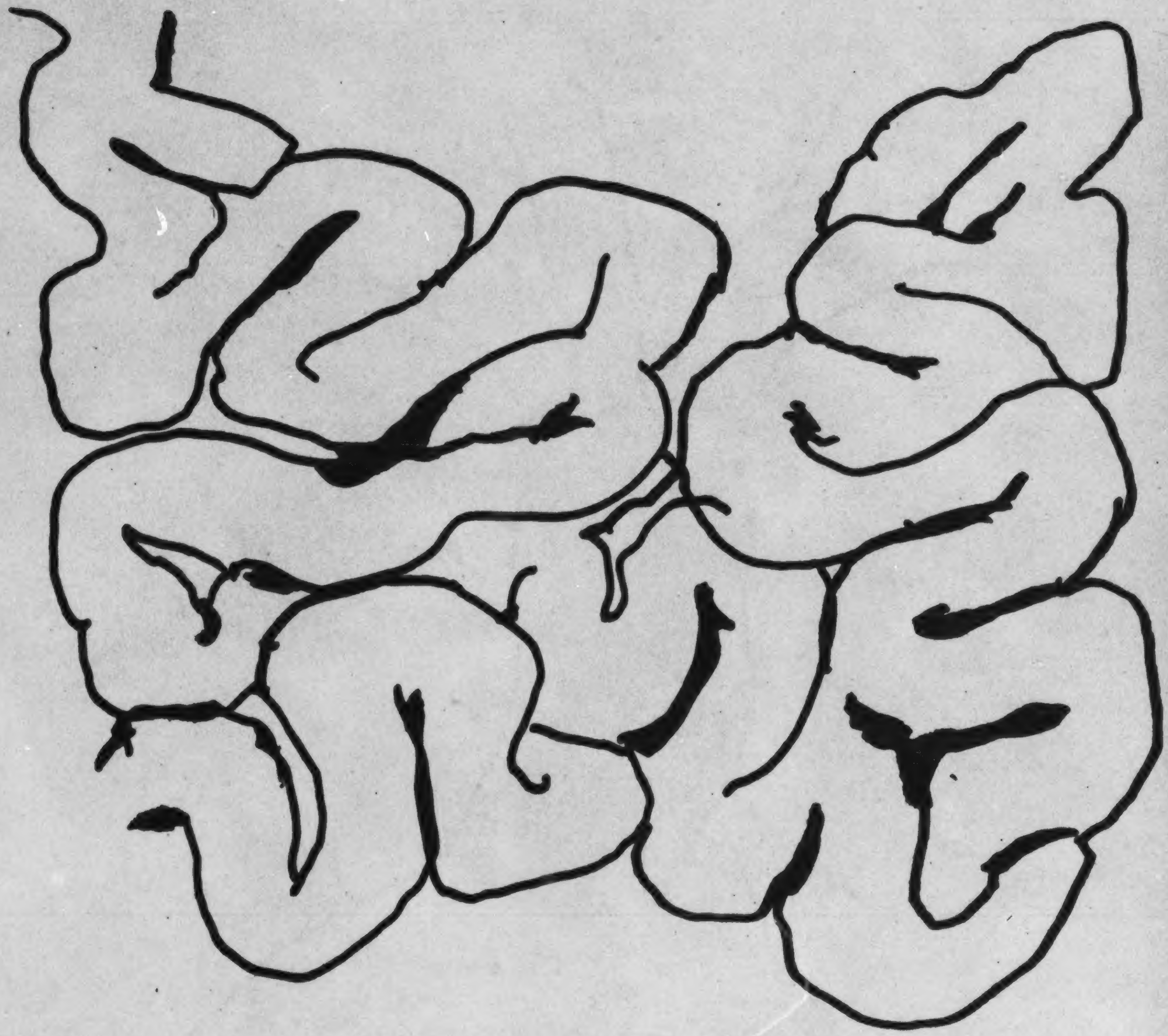
LARGE LEFT INTESTINE



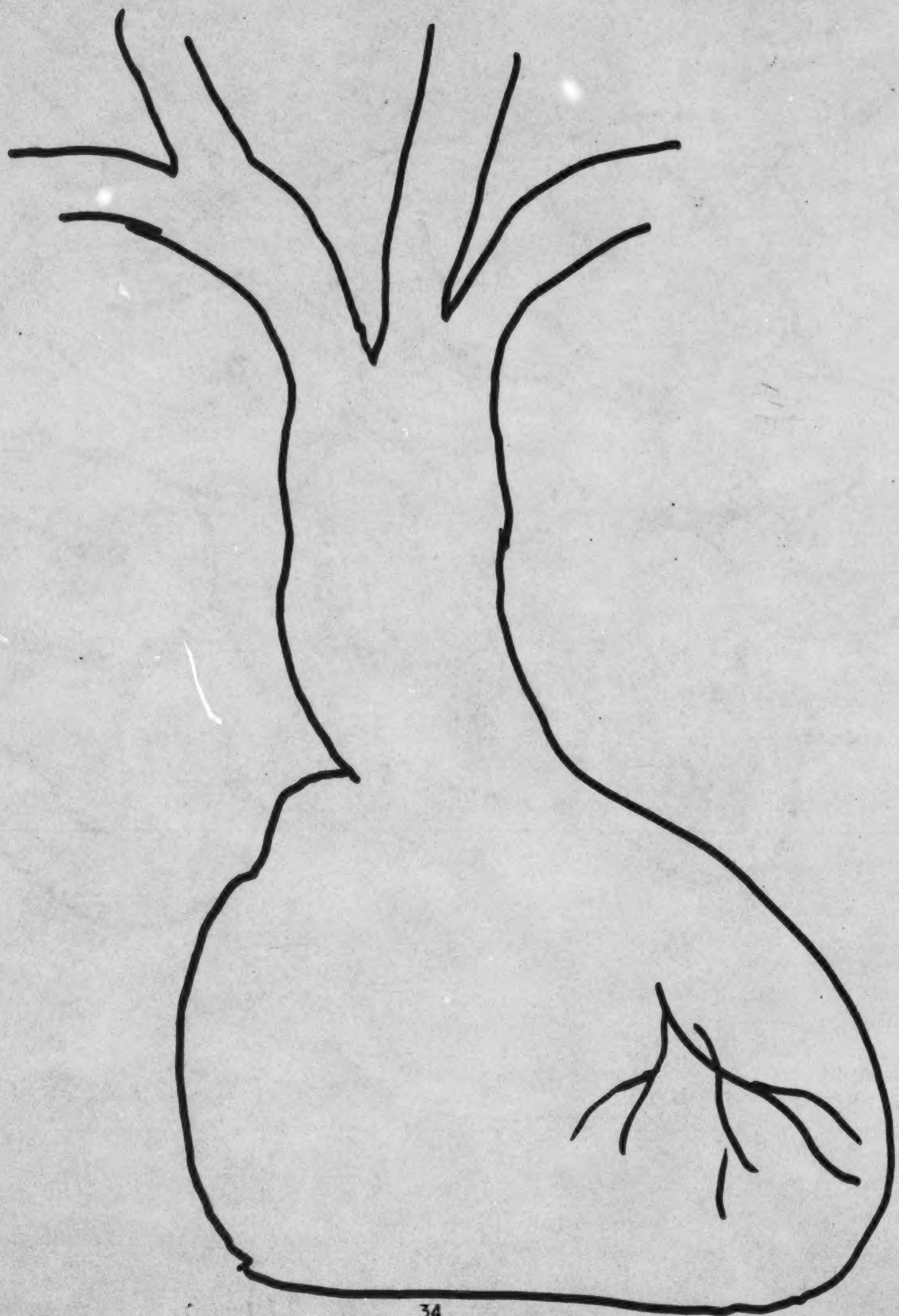


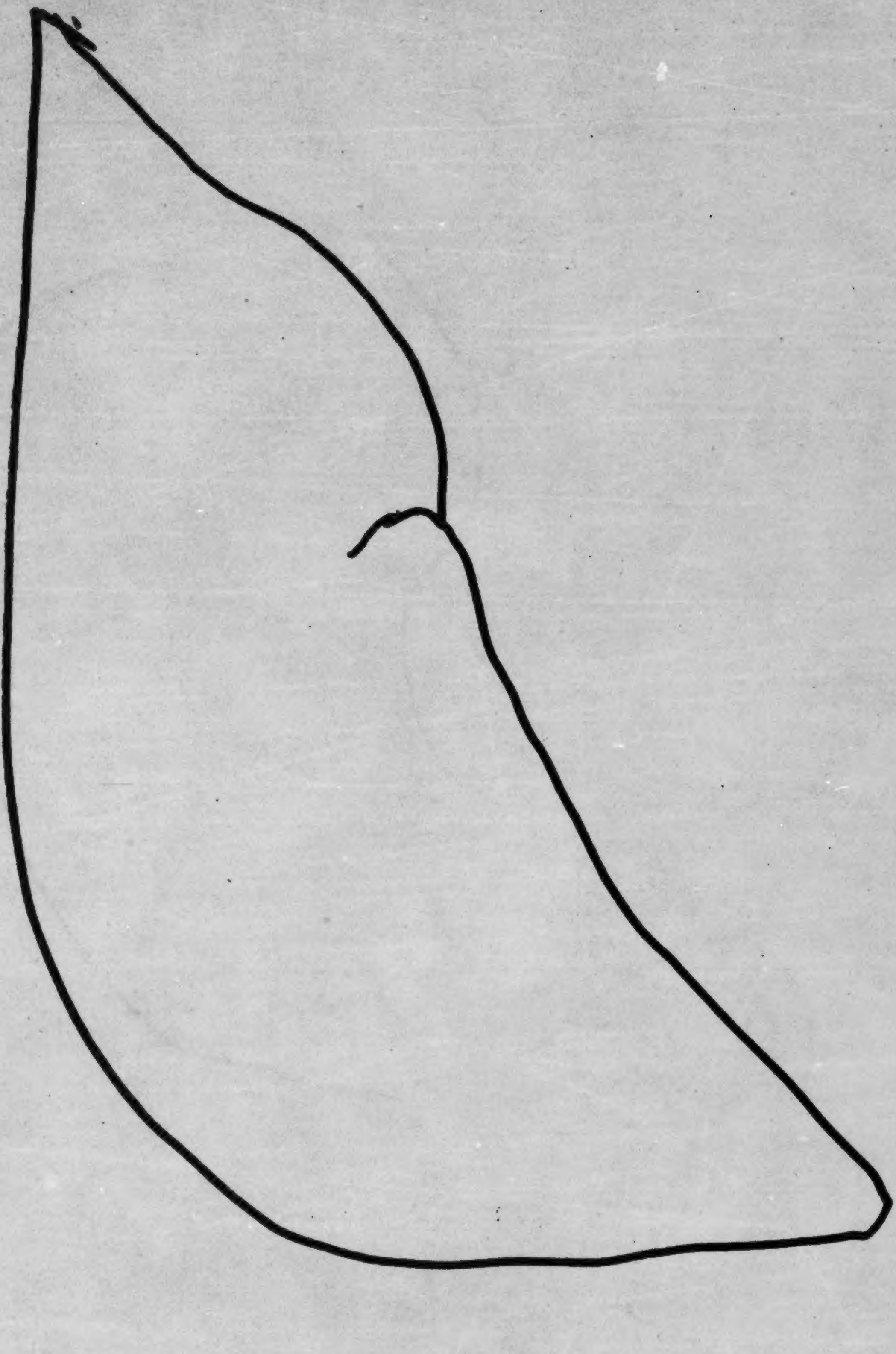
LARGE RIGHT INTESTINE

SMALL INTESTINES

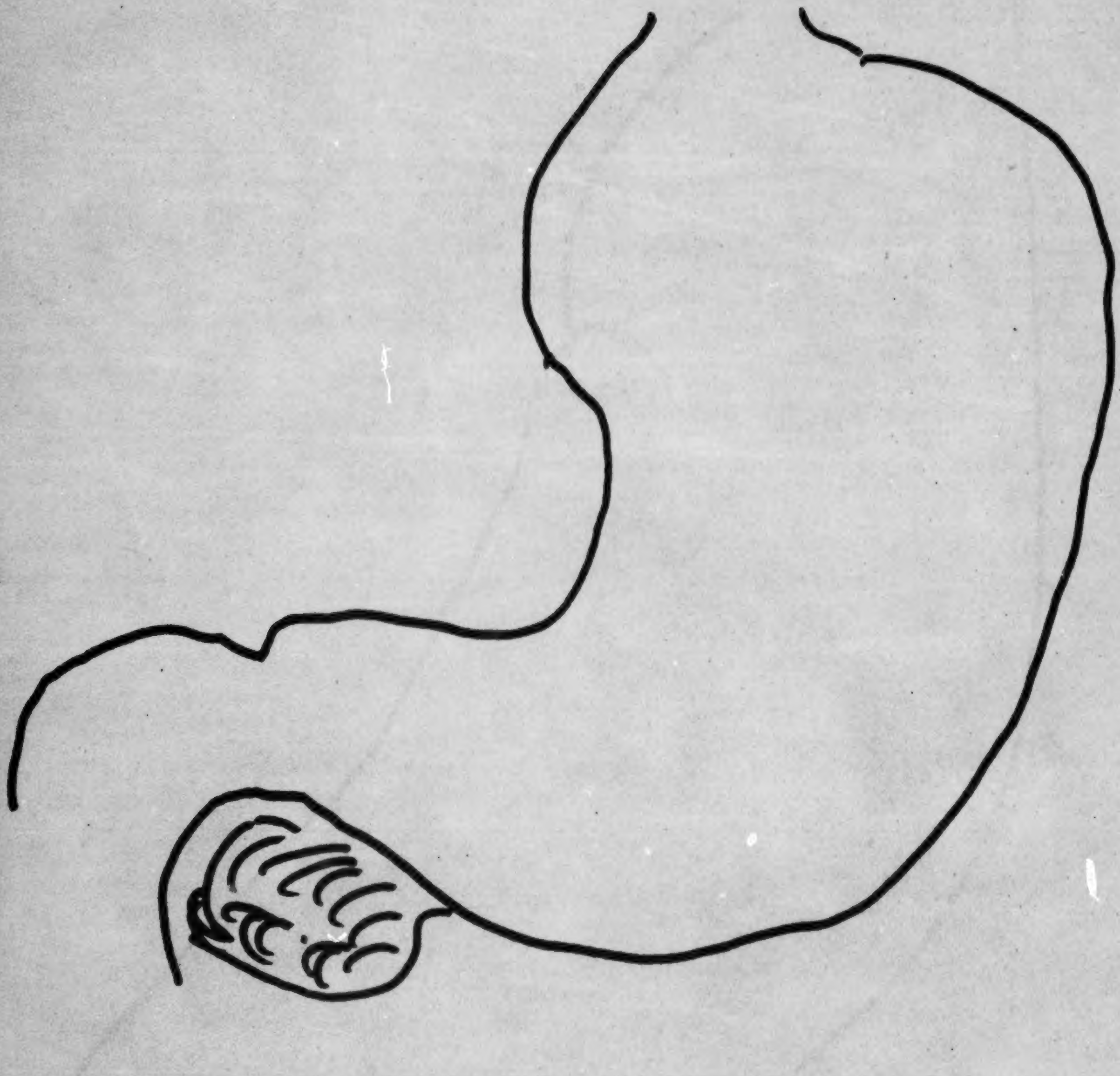


HEART




LIVER

STOMACH



Level 5 Unit 1 Adaptations

Part B Inside Adaptations, Lesson Cluster 1B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-72,74	Introduction/ Development	What Are Cells? Looking at Cells	60 min.
T-76	Development	Cell Structure	40 min.
T-77	Development	Cells in Your Body	40 min.
T-78	Application	One-Celled Organisms	45 min.
T-79	Evaluation	Properties of Cells	40 min.

NOTE: First 2 lessons in the cluster have been combined in order to make the introduction to a new concept more concrete.

B. MATERIALS: See list on page T-69

FILMSTRIP INFORMATION: Filmstrip Set X, Structural Systems, and XVII, Adaptations, are appropriate for use in this unit.

INTRODUCTION and DEVELOPMENT: Lesson Cluster 1B-2 Cells
Pages T-72-75/S-36-38 What Are Cells? and Looking At Cells (60 min.)

PURPOSE: Introduce and to develop the concept of cells by observing and comparing plant and animal cells. Note: If microscopes and other materials are not available, you may still do page 38 of this lesson.

ADVANCE PREPARATION:

Background Information: There is an exception to the definition of cells. Viruses are not made of cells. They are particles much smaller than cells, and are not capable of any metabolic life of their own. They live within cells of other organisms. They cannot even reproduce themselves without the aid of living cells. There is also disagreement as to whether viruses are alive.

Materials -1 box glass microscope slides
-1 box cover slips, for slides
-1 onion, cut into small pieces
-1 bottle of iodine
-newspaper, to cover desks
-1 elodea plant, available at aquarium supply shops
-crayons
-commercially prepared slides of plant and animsl cells (optional)
-unlined paper, several sheets for each student

Language Cards/Key Signs
a cell
a microscope
a nucleus
a slide
a plant cell
an animal cell

Identification Cards
a microscope
some plant cells
some animal cells

Materials -2 containers, 118 mL (4 oz.), for each pair of students
-One of the following for each pair of students:
microscope, 25X-22X or 50X-200X
tooth pick, flat, wooden

Collect all the materials and put them on a centrally-located supply table. Put about 1 mL of the staining solution into half of the containers and 1 mL of water into the other half so that each pair of students has 2 containers, 1 of staining solution and one of water.

In addition to the slides that the students prepare, you may wish to prepare other kinds of plant cells for viewing. Using a single-edged razor blade, cut thin translucent slices from a carrot, green pepper, celery, or radish. To mount, follow the directions for an onion skin on page 37. You may also wish to borrow some commercially prepared slides of plant and animal cells from a junior high or high school science class.

TEACHING SUGGESTIONS:

1. Explain to the students that they are going to look at pieces of food, plants, and themselves through the microscope. Explain that in order to do this they must prepare slides which will hold these different things under the microscope.

2. Ask the class if anyone knows what a cell is. Accept all ideas. Tell the students that they will learn about cells in this lesson.

3. Divide the class into groups of 2.

4. Have the students read the directions on page 37 for the activity, and stress that they should examine the pictures carefully.

5. Discuss the directions with the students when they have completed their reading. Choose one student in each group to scrape cells from his or her mouth. Stress that they should make sure to use the flat end of the toothpicks when scraping cells from inside their mouths. Also stress that when preparing the slides, there should be no air bubbles under the cover slip.

6. Caution the students against getting the iodine solution on their hands or faces or in their mouths. Tell them that iodine can make them very sick. Also tell them not to get the solution on their skill or clothes because it will stain.

7. Distribute the materials.

8. Have the students locate the main parts of the microscopes. Ask them first to find the magnifying lens, usually mounted in a tube that moves up and down or turns to adjust the focus of the image of whatever is on a slide. Next have the students find the stage, or platform, where a slide is placed. Show them where the focusing knob is. Finally, have the students find the mirror that focuses light upward.

9. Let the students begin the activity after they have practiced using the microscopes. It may be helpful to first demonstrate the activity or do the activity along with the students.

10. Encourage the students to share their observations with one another as they work and to describe what they see.

11. Explain to the students that they are looking at plant and animal cells. Ask them which of the samples are animal cells (mouth) and which are plant cells (onion and leaf).

12. Have the students read page 36. Teacher may paraphrase the information.

13. Have the students turn to page 38 when they have finished viewing their slides.

14. Have the students read page 38. Teacher may paraphrase the information.

15. Discuss the directions for drawing the cells with the students.

16. Let them proceed with their drawings when you are certain they understand what they are to do.

17. Discuss the students' drawings with them. You may wish to display the drawings on a bulletin board for future reference. Use the identification cards to label each area of the display.

18. Conclude the lesson with a discussion of the numbered questions on pages 36 and 38. Make sure that the students recognize leaf cells as having small green structures in them and thicker cell coverings. Onion cells also have thicker cell coverings, but no green structures.

DESIRED LEARNING OUTCOME: Ability to describe cells as tiny sections of living matter found in all plants and animals. Ability to draw plant and animal cells, and describe how they are alike and different.

****

DEVELOPMENT: Lesson Cluster 1B-2 Cells
Page T-76/S-39 Cell Structures (40 min.)

PURPOSE: Develop the concept of cells and their structures by introducing structures and functions of typical plant and animal cells.

ADVANCE PREPARATION: Materials -drawings of cells made in previous lesson

Language Cards/Key Signs
cell structures
a nucleus
a cell membrane
a cell wall

TEACHING SUGGESTIONS:

1. Begin the lesson by asking the students to recall the cell structures that they have observed in the previous lesson (nucleus, outside covering, tiny green structures).

2. Explain to the students that they will be able to learn more about cell structures in this lesson.

3. Have the students read the introductory paragraph and study the pictures on page 39. Teacher may paraphrase information.

4. Ask the students how the pictures compare with the pictures that they drew in the previous lesson. The pictures on page 39 are generalized cells that the students should be able to relate to their drawings. Help them to identify the nucleus, cell wall and cell membrane in their drawings.

5. Have the students read the remainder of the page and answer italicized questions to find out about the cell structures. Teacher may paraphrase information.

6. Discuss each structure with the students when thay have finished reading. Make sure that the students understand the difference between a cell membrane and a cell wall. When discussing the green structures, refer the students to the pictures of the root cells on page 36 and the onion cells on page 38. Have them relate the cells' lack of green structures to the plants' environments.

7. Answer numbered questions on page 39.

DESIRED LEARNING OUTCOME: Ability to name structures in plant and animal cells and describe their functions.

****

DEVELOPMENT: Lesson Cluster 1B-2 Cells
Page T-77/S-40 Cells in Your Body (40 min.)

PURPOSE: Extend the concept of cells and adaptation to specialized human body cells and their functions.

ADVANCE PREPARATION: Materials -picture of human nerve cells (optional)

Language Cards/Key Signs
human muscle cells
human skin cells
red blood cells
white blood cells

Identification Cards
human muscle cells
human skin cells
human blood cells

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students read the introduction to the lesson on page 40. Teacher may paraphrase information.

2. Explain to the students that the pictures on page 40 show human cells seen through a microscope. Ask them to speculate what the functions of the different kinds of cells might be.

3. Have the students read page 40 and answer the italicized questions. Teacher may paraphrase information.

4. Discuss the lesson with the students when they have completed their work, making sure that they can identify the kind of cell pictured in A, B, and C.

5. Have the students compare the skin cells shown in picture B with the mouth cells shown on page 38. Students should find that the cells are alike because they come from similar tissue.

6. Students may draw pictures of muscle, skin and blood cells and add them to the bulletin board display. Use the identification cards for labels.

7. Show a picture of human nerve cells to the students, if possible. Explain to the students that nerve cells connect to each other to form long nerves. Further explain that nerves reach all parts of the body and help them work. Ask the students to find the nucleus in muscle and nerve cells. Have them compare muscle and nerve cells.

8. Conclude the lesson by having the students respond to and discuss the numbered

questions.. Make sure that the students understand that muscle cells, skin cells, and blood cells are adaptations that help keep people alive.

DESIRED LEARNING OUTCOME: Ability to name 3 kinds of body cells and describe their functions.

****

APPLICATION: Lesson Cluster 1B-2 Cells
Page T-78/S-41 One-Celled Organisms (45 min.)

PURPOSE: To apply what students have learned about cells to various one-celled organisms.

ADVANCE PREPARATION: Materials
-pond water (see Advance Preparation, page T-78)
-crayons, several boxes
-paper, unlined
-pencils
One of the following for each pair of students:
-microscope
-glass slide
-cover slip
-medicine dropper
-containers, 118 mL (4 oz.)

Language Cards/Key Signs
pond water

Identification Cards
one-celled organisms from pond water

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to describe the smallest plant or animal that they have ever seen. After the students have had an opportunity to discuss their responses, explain to them that they will be learning about organisms that can be seen only with a microscope.

2. Have the students read the first two paragraphs, if they are to do the activity. Teacher may paraphrase.

3. Encourage the students to examine the pictures carefully.

4. Discuss the directions for preparing the slides with the students. Emphasize that there should be no air bubbles under the cover slip.

5. Distribute the materials, and have the students do the activity. Allow sufficient time for the students to draw several cells.

6. Drawings may be displayed using the identification card for a label.

7. Have the students read the remainder of the lesson and answer the questions.

8. Allow the students to share their responses with their neighbors as they work.

9. Discuss the lesson with the students when they have completed their work.

DESIRED LEARNING OUTCOME: Ability to describe one-celled organisms found in pond water.

****

EVALUATION: Lesson Cluster 1B-2 Cells
Page T-79/S-42 Properties of Cells (40 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Identifying cells, distinguishing between plant and animal cells, and identifying the structures within a plant cell that make food.
2. Identifying objects that are made of cells.
3. Naming organisms having more cells and fewer cells than a given organism.
4. Explaining why you cannot see most cells and describing how you could look at them.

TEACHING SUGGESTIONS:

1. Have the students turn to page 42 and read through the lesson. Teacher may paraphrase the questions.

2. Have the students proceed with the lesson when you are certain that they understand what they are to do.

3. Go over the responses with the students when they have completed their work.

4. Let the students correct their own papers, if you wish.

5. Collect the papers so that you can evaluate each indivdual's progress. If a student correctly responds to all or most of each question you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 1 Adaptations

Part C Behavioral Adaptations, Lesson Cluster 1C-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-86	Introduction	What is Behavior	25-35 min.
T-87	Development	Eye Behavior	45 min.
T-88	Development	Earthworm Behavior	50 min.
T-90	Development	Behaviors Have Functions	35 min.
T-92	Development	Inborn or Learned	35-40 min.
T-93	Application	Learn a Behavior	35-40 min.
T-95	Evaluation	Behaving	30-40 min.

NOTE: Lesson A Maze, T-94, has been omitted.

B. MATERIALS - See list on T-83.
See Advance Preparation on page T-88 before beginning cluster.
See Advance Preparation on page T-102 for next cluster.

FILMSTRIP INFORMATION: Filmstrip Set X, Structural Systems, and XVII, Adaptations, are appropriate for use in this unit.

INTRODUCTION: 1C-1 Animal Behavior
Page T-86/S-44 What Is Behavior? (25-35 min.)

PURPOSE: To introduce the concept of behavior.

ADVANCE PREPARATION: Materials - several magazines with pictures illustrating animal and human behaviors
Enough of the following to supply the entire class:
- scissors
- paste
- unlined paper
- crayons

Language Cards/Key Signs
behavior

Identification Cards
behaviors - use for title of bulletin board

TEACHING SUGGESTIONS:

1. Begin the lesson by asking the students to read the lesson title, What Is Behavior? Ask the students if they can answer the question. You may find from their responses that students think of behavior subjectively, as either positive or negative. As you proceed through the part, encourage students to refer to behavior objectively.

2. Have the students read the first paragraph on page 44 to find out about behavior. Teacher may paraphrase the text.

3. Discuss the term behavior with the students. Ask them if they can name any behaviors. It may help to use behaviors in the classroom during discussion as examples. Accept any responses that describe things organisms do, except internal activities such as digesting food and breathing.

4. Have the students read the remainder of page 44 and answer the questions. Teacher may paraphrase the text and questions.

5. Discuss the lesson with the students when they have finished their work. If you find that students have trouble identifying behaviors, you may wish to provide further practice in a similar activity. You may cut pictures from magazines and use the numbered questions with the pictures. This can be done as a class, or individually.

7. Extend the lesson by having students make a bulletin board display entitled Behaviors as a class or a free-time activity. Point out to them where you have put the materials that they may use for their pictures. They may either cut out pictures from magazines or draw pictures of animal or human behaviors. As the students proceed through the part, they can add pictures of animals and plants exhibiting behaviors as well as other information that they may gather.

DESIRED LEARNING OUTCOME: Ability to name some behaviors and describe how they might be responses to an organism's environment.

****

DEVELOPMENT: 1C-1 Animal Behavior
Page T-87/S-45 Eye Behavior (45 min.)

PURPOSE: Develop the concept that behavior is often a response to the environment, by observing the pupil in response to changing light conditions.

ADVANCE PREPARATION: Materials - 1 pupil measuring card for each student

(Duplicate and cut out enough pupil-measuring cards from Appendix A, page T-532, so that each student or pair of students will have one card. There are four cards on the page, so you will only need to duplicate one fourth of the number needed. You may wish to have students help with cutting the cards apart.)

- at least one mirror

1. Duplicate the chart on page 45 either on the board or a transparency.

Language Cards/Key Signs
eye behavior
pupil

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students if they can name an eye behavior. Students may remember blinking from the previous lesson.

2. Ask the students to read the introduction to the activity on page 45 to find out about another kind of eye behavior. Teacher may paraphrase the text.

3. Discuss the term pupil with the students. Make sure that they can identify the part of the eye to which the term refers. Have the students identify their classmates pupils and their own pupils by looking in a mirror.

4. Have the students read the directions to the activity. Teacher may paraphrase. Use a blackboard or transparency copy of the chart on page 45 to explain how it is to be filled in.

5. Tell the students that to measure in bright light, the students being measured should look out of a window or sit in sunlight. For shadow, they should just turn off the light in the room. Finally, for dark, students should cover the eye with a hand for several minutes to give the pupil time to open.

6. Distribute the materials to the students and let them examine the pupil-measuring cards.

7. Let them begin the activity when you are certain that they understand what they are to do.

8. Discuss the italicized questions with the students when they have finished the activity. You may want to draw a large chart on the chalkboard and compute the class average pupil size.

9. Have the students respond to and discuss the numbered questions.

DESIRED LEARNING OUTCOME: Ability to measure a classmate's pupil size in bright light, shadow and dark and identify the pupil's changing size as a behavior.

****

DEVELOPMENT: IC-J Animal Behavior
Page T-88/S-46 Earthworm Behaviors (50 min.)

PURPOSE: Develop the concept that behavior is often a response to the environment and to introduce the concept that behaviors as well as structures can be adaptations.

ADVANCE PREPARATION: You may obtain earthworms from a bait shop or have students bring them to class. The earthworms should be stored in a container of soil. The soil should be kept moist so that the earthworms won't dry out. You may use direct sunlight as well as a lamp or flashlight for experiment A. It is advisable to have some type of artificial light in case of cloudy weather. Just before class, add soil and four worms to each box and fill the containers with water.

Language Cards/Key Signs
earthworm
adaptation

Identification Cards

Materials - The class should be divided into groups of 4 students for this lesson. The following materials are needed for each group:

- soil, about 1 lb.
- 3 earthworms
- 1 box, such as a sweater box (2" x 8½" x 11")
- 1 flashlight or desk lamp
- 1 piece of black paper (9" x 12")
- 1 container of water (8 oz.)
- 3 paper towels
- 1 dinner plate
- 3 ice cubes

Also have for the class:

- 1 spray bottle of water
- 1 container of water for class supply

TEACHING SUGGESTIONS:

1. Initiate a discussion by asking the students to describe earthworm behavior. Refer the students to the photo of the earthworm on page 29. Many students may want to share their experiences with earthworms when using them for bait, or when finding them while digging in soil.
2. Have students read first paragraph on page 46. Teacher may paraphrase text.
3. Briefly review the term adaptation with the students.
4. Have students read the next 3 paragraphs. Teacher may paraphrase text.
5. Discuss the earthworm and its environment with the students.
6. Have the students read the next paragraph and the directions for experiment A. Stress that the pictures are examples of how they will do each experiment. Encourage them to examine the appropriate picture carefully.
7. Discuss the directions with the students. Explain that the paper towel should be moist, not soaked. They can keep the towel and earthworms from drying out by spraying the towel with water from a spray bottle.
8. Divide the students into groups of 4 to do the experiments.
9. Show the students where the materials are located and let them to experiment A.
10. Discuss the related italicized questions with the students when they have completed experiment A. Note the results of the experiment on the chalkboard for future reference.
11. Have the students read the directions for experiments B and C on page 47. Again stress the importance of the picture.
12. Discuss the directions with them. Explain that they should work quickly so that the earthworms will not dry out during the experiments.

13. Have them do the experiments when you are certain that they understand what they are to do.

14. Allow them to share their responses to the italicized questions as they work. Record the results of the two experiments on the chalkboard.

15. Have the students respond to and discuss the numbered questions.

16. Discuss earthworm behavior as an adaptation. Make sure the students understand that behaviors, as well as structures, have functions and are adaptations.

17. Replace the earthworms in their natural environment.

18. Review the results of the 3 experiments that were recorded on the board.

DESIRED LEARNING OUTCOME: Ability to identify and describe earthworm behavior and tell how they are adaptations.

****

DEVELOPMENT: 1C-1 Animal Behavior
Page T-90/S-48 Behaviors Have Functions (35 min.)

PURPOSE: To develop the concept that behavior is often a response to the environment and to introduce the concept that behaviors as well as structures can be adaptations.

ADVANCE PREPARATION: The pictures in this lesson may be used for discussion about different animal behaviors and their role as an adaptation for survival.

Language Cards/Key Signs
deer
spider
monkeys
geese
racoon
rabbit
bobcat
adaptation

Identification Cards

TEACHING SUGGESTIONS:

1. Discuss each picture with the class by asking them what the animals are doing, and how this behavior helps them to survive.

2. Have the students read the first paragraph on page 48 to find out about other kinds of adaptations. Teacher may paraphrase.

3. Discuss behavior as an adaptation with the students. Make sure they understand that behaviors, as well as structures, have functions and are adaptations.

4. Have the students read about the animals pictured on pages 48 and 49.

5. Discuss the pictures with the students using the italicized question as a guide.

6. Have the students respond to and discuss the numbered questions. Make sure the students understand that structure and behavior are related.

DESIRED LEARNING OUTCOME: The students should be able to identify behaviors and explain how they are adaptations.

****

DEVELOPMENT: 1C-1 Animal Behaviors
Page T-92/S-50 Inborn or Learned (35-40 min.)

PURPOSE: Extend the concept of behavior to the distinction between inborn and learned behaviors.

Language Cards/Key Signs
inborn behaviors
learned behaviors

Identification Cards

ADVANCE PREPARATION: Background Information - In practice it is not always possible to tell whether a behavior is inborn or learned. A learned behabior always involves inborn capabilities.

TEACHING SUGGESTIONS:

1. Introduce the lesson by having the students read the first sentence on page 50. Discuss this question with the students. Accept all opinions and record some of them on the board. In order to stimulate discussion have the students look at the first picture on page 50. Ask them what the birds are doing, what behavior do they see. After everyone understands what the birds are doing, return to the original question. Pictures from pages 48-49 may also be useful.

2. Have the students read the rest of the paragraph. Teacher may paraphrase the text.

3. Ask the students to compare their original ideas to what they read.

4. Have the students read the next paragraph. Teacher may paraphrase.

5. Write the term inborn on the chalkboard. Discuss the term with the students, making sure they understand its meaning.

6. Have the students read the remainder of the lesson and answer the numbered questions.

7. Discuss the lesson with the students when they have completed their work. You may ask students to name animal behaviors and discuss whether the behaviors are inborn or learned. Some possibilities for discussion are inborn behaviors such as caterpillars spinning cocoons, spiders spinning webs, and insects cooperating. Examples of learned behaviors might be young birds learning to fly, avoidance of food that doesn't taste good, and oystercatcher birds teaching their young to break the shells of mussels. Also discuss how learned behavior may be partly inborn.

DESIRED LEARNING OUTCOME: Ability to identify behaviors as inborn or learned and describe how it is an adaptation.

****

APPLICATION: 1C-1 Animal Behaviors
Page T-93/S-51 Learn a Behavior (35-40 min.)

PURPOSE: Apply the concept of learned behaviors to humans by learning a new behavior in class through practice.

ADVANCE PREPARATION: Materials - 1 stop watch

Language Cards/Key Signs
practice
learned behavior
trial

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they will have a new learned behavior by the end of the lesson.

2. Have the students read the first four paragraphs on page 51 to find out what they are to do. Teacher may paraphrase.

3. Have all members of the class except one stand around the periphery of the room holding hands. The person on either end of the line has a hand free. The person not in the line will be the timer.

4. Have the students do the activity when you are certain they understand what they are to do. Make sure that the student starting the squeezing is the one with his or her right hand free.

5. Discuss the italicized questions with the students when they have finished the activity. Stress that as you learn by practicing, speed increases. You may want to graph the results on the board, or have students graph them. Plot time on the vertical axis and the number of trials on the horizontal axis. Most graphs will probably show a decrease in learning time for the first three or four trials and then a leveling off.

6. Have the students respond to and discuss the numbered questions. Discuss how improving reaction time can be advantageous, such as avoiding danger or getting to food.

DESIRED LEARNING OUTCOME: Ability to learn a behavior by practicing.

****

EVALUATION: 1C-1 Animal Behavior
Page T-95/S-53 Behaving (30-40 min.)

PURPOSE: To evaluate the students' performance in reference to the following objectives:

1. Describing how given behaviors are adaptations.
2. Identifying animal behaviors as inborn or learned.
3. Identifying what information is needed to find out how a behavior helps an animal.
4. Describing how an animal learns a behavior.

TEACHING SUGGESTIONS:

1. Have the students turn to page 53 and read through the lesson. Teacher may paraphrase text and questions, and write the questions on the board.

2. Have the students proceed with the lesson when you are certain that they understand what they are to do.

3. Go over the responses with the students when they have completed their work.

4. Let the students correct their own papers, if you wish.

5. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 1 Behavioral Adaptations

Part C Plant Behavior, Lesson Cluster 1C-2

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-100	Introduction	Responses of Plants	40-45 min.
T-102	Development	Behavior in Light	35-40 min.
T-103	Enrichment	Tendril Response	40-45 min.
T-104	Development	Response to Gravity	40-45 min.
T-108	Evaluation	Changes in Plants	35-40 min.

NOTE: Lessons Growing in the Right Direction, T-106, and Planning a Garden, T-107, have been ommitted.

B. MATERIALS: See list on T-97 and Advance Preparation on T-102.

FILMSTRIP INFORMATION: Filmstrip Set X, Structural Systems, and XVII, Adaptations, are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 1C-2 Plant Behavior
Page T-100/S-54 Responses of Plants (40-45 min.)

PURPOSE: Introduce the concept that plants as well as animals behave in response to their environment.

ADVANCE PREPARATION: Materials -The following plants are optional:
-Venus Fly Trap
-mimosa plant
-cucumber, squash or pea
- plant

Language Cards/Key Signs
plant behavior
Venus Fly Trap
mimosa plant
cucumber, squash or pea plant

Identification Cards
Venus Fly Trap
mimosa plant
cucumber, squash or pea plant

You may wish to obtain a Venus Fly Trap, a mimosa plant and a plant with tendrils such as cucumber, squash or pea plant for the students to observe. Having the plants in the classroom will help the students to compare the plants' properties and behaviors as well as the speeds with which the plants can move. Use identification cards to label each plant.

Background Information: Venus Fly Traps grow naturally in a small coastal region in North and South Carolina. The soil in which the plants live lacks a sufficient amount of nitrogen. A plant gets the nitrogen it needs by digesting the soft parts of insects. There are three sensitive hairs on each leaf that trigger the leaf to close like a trap when an insect lands on one of them. Note that Venus Fly Trap is not spelled the common way, Venus's-flytrap. This is done intentionally to aid in readability.

The mimosa is a very sensitive plant, whose leaves can move if they are touched.

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students read the first paragraph on page 54. Teacher may paraphrase text.

2. Ask the students if they have ever noticed a plant behave in a certain way. If students mention plants moving with the wind as a behavior, explain to them that this motion is not a behavior because the plant is being moved rather than moving by itself.

3. Have the students read the remainder of the page and study the photographs. If you have a sample show it to the class.

4. Discuss the the Venus Fly Trap with the students. You may wish to share the information in Background Information with them at this point. Have them describe the outside structures of the plant that they can observe in the pictures. Make sure that the students realize that the pictures of the Venus Fly Trap are a sequence of photos of the same plant, showing it trapping an insect.

5. Have the students turn to and read page 55. Teacher may paraphrase.

6. Allow the students to discuss the pictures. If you have real mimosa plants and a plant with tendrils, let the children examine them.

7. Students should answer numbered questions and share their responses.

8. Discuss the lesson with the students when they have finished the page. When discussing tendrils remind students of the application lesson in Cluster 1A-2 about plant structures that keep in certain positions. If there are plants in your region that display similar behavior to those in this lesson, you may wish to discuss them with the students. Also discuss other plant behavior such as flowers that open and close.

9. Conclude the lesson by asking the students to name the outside structures that allow a plant to behave the way it does. Venus Fly Traps have leaves that can close around insects; mimosa plants have leaves that can turn; and many vines have tendrils that can wrap around objects.

DESIRED LEARNING OUTCOME: Ability to describe three plant behaviors.

****

DEVELOPMENT: Lesson Cluster 1C-2 Plant Behavior
Page T-102/S-56 Behavior in Light (35-40 min.)

PURPOSE: Develop the concept that plants have behavioral adaptations by studying growth in the direction of sunlight.

ADVANCE PREPARATION: Materials
- -seedlings that have to be started roughly 1½ weeks earlier
- -4 cartons (1 ft.) with 1 open side
- -paper and pencil for each child

Language Cards/Key Signs

Identification Cards
(labels for the seedlings)

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to recall the plant they studied that behaved in response to sunlight (mimosa). Explain to the students that they will be able to observe behavior in response to light in other kinds of plants.

2. Have the students read the first paragraph on page 56. Teacher may paraphrase.

3. Discuss the paragraph with the students. Check their understanding by asking them to name environmental factors that, if changes, might cause plants to show behavior (heat, light, soil, air, water, etc.).

4. Have the students read the directions for the activity.

5. Discuss the directions with the students, pointing out the location of the materials.

6. Choose several students to place the potted seedlings in the cartons and arrange the cartons near the window. The same combination of plants should be in each carton.

7. Have the students, individually, or in groups, go up to the cartons, observe the plants, and record the directions in which the plants are growing. A chart like the one below may be used to record direction.

	DIRECTION
A	Open side toward window
B	Open side toward blackboard
C	Open side toward left wall
D	Open side toward right wall

8. Ask the students to predict in which directions the plants will grow.

9. Appoint one or more students to be in charge of watering the plants for the duration of the week.

10. Have the students again observe the plants after one week.

11. Discuss the numbered questions with the students. In discussing question 2, you may have students dig up some of the plants and observe the direction in which the roots have grown.

DESIRED LEARNING OUTCOME: Ability to identify plant growth toward sunlight as a behavior.

* * *

ENRICHMENT: Lesson Cluster 1C-2 Plant Behavior
Page T-103 Tendril Response (40-45 min.)

PURPOSE: To extend the concept that plants have behavioral adaptations by observing tendril response to string, and comparing the heights of plants grown with and without string supports. This lesson does not appear in the student text.

ADVANCE PREPARATION: Materials -Have enough of the following so each pair of students will have:

-2 foam sups 237 mL (8 oz.)
-soil for each cup
-pencils
-container of water
-10 pea seeds
-1 wooden dowel 35 cm (14 in)
-string 35 cm (14 in)
-scissors
-metric ruler

Language Cards/Key Signs
tendrils
tendril response

Identification Cards
pea plants grown with string
pea plants grown without string

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to recall the definition of a tendril (a thin shoot that can wrap around a thin object).

2. Explain to the students that they will be able to observe tendril behavior.

3. Divide the students into groups of 2 and distribute the materials.

4. Have each group poke small holes in the bottom of the cups and then plant five pea seeds in each of two cups. The soil and cups should be the same for each population.

5. Have the students set a string for one of the two cups of plants. To do this they should tie one end of a string securely to one end of a dowel, then push the other end of the dowel into the soil near the rim of the cup. Next they should tape the free end of the string to the side of the cup opposite the dowel.

6. Tell the students to be sure to place both cups in the same amount of light and water them equally.

7. Write the following chart on the chalkboard for the students to copy.

Week	Date	Heights of Plants Grown With String	Heights of Plants Grown Without String
1		cm	cm
2		cm	cm
3		cm	cm
4		cm	cm

8. Explain to the students that they should measure and record the average heights in each cup every week for four weeks. Provide help in calculating the averages.

9. Discuss the activity with the students when they have filled in the entire chart. The students should find that the plants in the cups with the string are higher.

10. Ask the students how a tendril's response to a string is an adaptation (keeps the plant's leaves high and exposed to light).

DESIRED LEARNING OUTCOME: Ability to describe how tendril behavior is an adaptation.
****

DEVELOPMENT: Lesson Cluster 1C-2 Plant Behavior
Page T-104/S-57 Response to Gravity (40-45 min.)

PURPOSE: Develop further the concept that plants have behavioral adaptations by observing how sprouting seeds respond to being placed in different positions.

Language Cards/Key Signs
gravity
roots
stem

ADVANCE PREPARATION: Note - Before gathering materials, read the Teaching Suggestions and decide whether the seed "sandwich" will be made by the children or demonstrated by the teacher. Once you have decided collect the following materials for each seed "sandwich."

Materials -2 panes of glass, 20 cm x 25.5 cm (8 in. x 10 in.)
-4 seeds, bean or corn
-2 paper towels
-2 rubber bands, size #33
-1 bowl, with bottom 30 cm (1 ft.) in diameter, 18 cm x 28 cm x 4 cm (7 in. x 11 in. x 1½ in.) with water 3 cm deep
-masking tape

The glass can be purchased and cut to size at most hardware stores. Before distributing glass to the students, cover all the edges with masking tape to prevent any possibility of cuts. If you are unable to obtain enough glass for the groups, you may do the activity as a demonstration.

Bean or corn seeds work best in this lesson. The seeds should be soaked overnight in water before the day they are to be used.

TEACHING SUGGESTIONS:

1. Introduce the lesson by throwing an object into the air, and catching it. Ask the children whether they were surprised that the object came back down. Have them explain why. Most students will probably say that gravity is involved. Offer no further explanation of gravity at this time because gravitational force is introduced in Unit 2, FORCES.

2. Have the class read the first three paragraphs on page 57. Teacher may paraphrase. Ask the students what effect they think gravity might have on a plant's growth. Do not offer any opinions.

3. Have the class read paragraph four.

4. Distribute the paper and let the students make their charts. Stress that they should make their charts as large as possible to have room for their drawings.

5. Have the students read the instructions for making a seed "sandwich."

6. Divide the class into groups of 2 to make the sandwich, or, make the sandwich as directed on the text page, as the students look on. If students do the activity themselves, caution them to handle the glass panes very carefully to prevent breakage and cuts. Make certain that the four seeds are oriented differently as shown. The water level should contact the edge of the towels in the sandwich at all times.

7. Have the students make a drawing in box A of their charts to show the placement of seeds.

8. Have the students read the remainder of the lesson. It will be necessary to wait a few days before completing the drawing in box B. Each morning and afternoon the roots on each seed may be measured, and that measurement recorded in the students' charts, as well as one that might be kept on one side of the chalkboard. It will be necessary to wait two or three more days before completing diagram C. Additional time will also be required before the students are ready for box D, and finally E. Nonetheless, have them continue to record the daily growth of the seedlings, as well as the changes in direction. They may read and discuss appropriate lines of text with each passing day.

9. Conclude the lesson with a discussion of the numbered questions. Have the students discuss the difference in the way roots and stems respond to gravity.

DESIRED LEARNING OUTCOME: Ability to explain that no matter how a seed is oriented when it is planted, the roots will grow downward and the stems will grow upward in response to gravity.

****

EVALUATION: Lesson Cluster 1C-2 Plant Behavior
Page T-108/S-61 Changes in Plants (35-40 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Matching environmental factors with responding plant behaviors.
2. Naming the environmental factors a plant(s) responded to and describing how its behavior is an adaptation.

TEACHING SUGGESTIONS:

1. Have the students turn to page 61 and read through the lesson. Teacher may paraphrase text and questions. Question 2 should be omitted since it is based on a lesson that was not done.

2. Have the students proceed with the lesson when you are certain that they understand what they are to do. Make sure they can identify pictures A, B and C.

3. Go over the responses with the students when they have completed their work.

4. Let the students correct their own papers, if you wish.

5. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

6. For further informal evaluation, have the students turn back to page 43 and look at the picture that introduces Part C. Ask them why they think that particular picture was used to introduce the part that they just completed. Suggest that they look for clues in the part title and in the cluster titles on pages 44 and 54. The students should be able to:

   a. identify plant behaviors such as tendrils climbing up posts and columns and morning glories all facing the same direction with some flowers open and some closed;
   b. identify sunlight, objects, and gravity as environmental factors to which the plants are responding;
   c. identify animal behaviors such as birds building a nest, a cat stalking birds, and birds flying away;
   d. describe how the plant and animal behaviors are adaptations.

****

Level 5 Unit 1 Adaptations

Part D Animal Stages, Lesson Cluster 1D-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-114	Introduction	Growth in Organisms	30-40 min.
T-115	Development	Stages of Mealworms	40-45 min.
T-117	Development	A Chicken Egg	40-45 min.
T-120	Development	Parents and Offspring	40-45 min.
T-122	Application	Human Stages	25-30 min.
T-123	Evaluation	Living in Stages	40-45 min.

NOTE: Lessons Stages of Frogs T-116 and Egg Adaptations, T-118 have been omitted.

B. MATERIALS: See list on T-111. See Advance Preparation on T-115, Stages of Mealworms.

FILMSTRIP INFORMATION: Filmstrip Set X, Structural Systems, and SVII, Adaptations, are appropriate for use in this unit.

INTRODUCTION: 1D-1 Animal Stages
Page T-114/S-63 Growth in Organisms (30-40 min.)

PURPOSE: Introduce the concept that organisms go through stages as they grow, and that different stages have different adaptations.

ADVANCE PREPARATION: Materials - none.

Language Cards/Key Signs
stages
organisms
adaptations

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students read the first paragraph on page 63. Teacher may paraphrase the information.
2. Check to make sure the students understand the answers to the riddles.
3. Have the class read the next paragraph, and look at the pictures. You may refer to pictures of tadpole and frog on page 65.
4. Ask the class if they would have been able to predict what a caterpillar would look like when it grew into an adult.
5. Have the students read the third paragraph. Teacher may paraphrase.

6. Explain to the students that adaptations for reproduction help populations rather than single organisms. Ask them why this is true (Adaptations for reproduction do not help an organism stay alive. Reproduction, however, helps keep populations alive). This is an extension of the meaning of adaptation used until now in this part of the unit. Until now, adaptation related only to individual survival.

7. Have the students read the remainder of the lesson and answer the questions.

8. Let the students share their responses with their neighbors as they work.

9. Discuss the lesson with the students when they have completed their work. Make sure that the students understand that almost all living things go through life stages and that each stage has different adaptations.

DESIRED LEARNING OUTCOME: Ability to state that organisms go through life stages, and that organisms have different adaptations at each stage.

* * *

DEVELOPMENT: 1D-1 Animal Stages
Page T-115/S-64 Stages of Mealworms (40-45 min.)

PURPOSE: Develop the concept of very different life stages in animals, and of different stages having different adaptations.

ADVANCE PREPARATION:

Background Information - Mealworms go through what is known as "metamorphosis." The larval stage of a mealworm lasts between four to five months. Molting will occur ten to twenty times. The pupa stage lasts two to three weeks. Two or three weeks later a grain beetle will emerge.

Materials - For this activity the students will work in pairs. Have enough of the following so that each team has:
- several mealworms*
- 1 glass jar with screw-on lids, 473 ml (16 oz)
- 2 or 3 tblsp. of bran flakes
- 1 slice of apple
- 1 finishing nail
- 1 hammer - this could be shared among the groups
- 4 sheets of unlined paper

Language Cards/Key Signs
mealworms
life stages
egg
larva
pupa
beetle
molting

*You can obtain mealworms from pet shops or science supply houses in quantities of fifty or one hundred. Because the larval stage lasts several months, you may wish to request old mealworms.

TEACHING SUGGESTIONS:

1. Have the students read the first paragraph on page 64 and carefully examine the pictures of the three stages. Teacher may paraphrase information.

2. Have the students read the next paragraph to find out what they are going to do.

3. Discuss the directions with the students. Explain to them that mealworms cannot hurt them. Further explain that they can gently touch them and pick them up.

4. Divide the students into groups of 2 and distribute the materials.

5. Have the students set up the mealworms in the jars. Help them to poke holes in the jars carefully using hammers and nails.

6. Have the students read the next 3 paragraphs, describing the larva, pupa and beetle stages.

7. Students should draw a picture of the mealworm as they observe it in the jar, and provide time for them to make their drawings as the mealworms go through stages. You may wish to discuss the questions with the students now, or wait until all the stages have been seen, or both.

DESIRED LEARNING OUTCOME: Ability to name and describe four life stages of a mealworm and describe adaptations at each stage.

* * *

DEVELOPMENT: 1D-1 Animal Stages
Page T-117/S-66 A Chicken Egg (40-45 min.)

PURPOSE: Develop the concept of life stages in animals by introducing the life stages of a chicken egg.

ADVANCE PREPARATION: Materials - For this activity the students will work in pairs. Have enough of the following so that each team has:

- 1 egg
- 1 bowl
- 1 scissors
- 1 magnifier 3x

Each student should also have:

- 1 sheet of white, unlined paper
- pencil
- yellow, brown crayons

Language Cards/Key Signs
chicken egg
egg shell
yolk
egg white
properties

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by holding up a chicken egg for the class to see. Ask the students to compare the egg with the egg stage in one of the previous alternate lessons. They should compare size, shape, color, and texture.

2. Have the students read the first paragraph on page 66. Teacher may paraphrase. Ask them if they can remember what kind of behavior, inborn or learned, it is when a chick pecks its way out of the shell (inborn).

3. Divide the students into groups of 2 and distribute the materials.

4. Have the students read the second paragraph and do this part of the activity.

5. Move around the room making sure that the students are listing only the properties of the eggs.

6. Discuss the properties with them when they have finished their lists. Have one student write a class list of properties on the chalkboard so that students can compare their observations with others. In discussing the properties mention that chicken eggs may be white or brown, but other than color, they are the same.

7. Have the students read the directions for doing the second step of the activity, in the third paragraph.

8. Discuss the directions with the students. Explain to them that when opening the eggs, they should try not to break the yolks. If a yolk does break, put the egg aside and have the students try again with another egg.

9. Have the students do the activity.

10. Let each group share their observations with the rest of the class when they have completed the activity. If a group broke a yolk, use their experience to emphasize how the shell protects the fragile inside structures. If any group had a growing chick on the yolk, have the rest of the students take turns observing it.

11. Have the students respond to, and discuss the numbered questions. You may want to begin a new list of chicken egg adaptations on the chalkboard.

12. Have each student draw a diagram of their egg, labeling as many parts as they can see.

DESIRED LEARNING OUTCOME: Ability to name and describe chicken egg adaptations.

****

DEVELOPMENT: 1D-1 Animal Stages
Page T-120/S-68 Parents and Offspring (40-45 min.)

PURPOSE: To develop the concept that parent and offspring stages have their own sets of behaviors that allow the parents to help the offspring.

ADVANCE PREPARATION: Materials - none.

Language Cards/Key Signs
parents
offspring
adaptations

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to read the first two paragraphs on page 68. Teacher may paraphrase, stressing that parent animals help their offspring or babies to stay alive. The idea that an individual animal may sacrifice itself for the preservation of the population may be too difficult for the students to understand and so need not be stressed.

2. Encourage the children to discuss any behavioral adaptations that they can think of that might help young animals get help from their parents. Ask the class what kind of help young animals might require from their parents. (Food and protection will probably emerge as the two major areas of need.)

3. Ask the class whether they can think of any behavior on the part of parent animals that might help the young to survive, even though it might cause the parents' demise. (Leading predators away from the nest, as was the case with the oystercatcher discussed in the last lesson, is one such example.)

4. Teacher should paraphrase the remainder of the text, using the pictures to illustrate the animal behavior being described.

5. Have the students respond to, and discuss the numbered questions. During discussion emphasize that behavioral adaptations of parents often help the population rather than the individual parents.

DESIRED LEARNING OUTCOME: Ability to identify and describe behavioral adaptations unique to parents and offspring.

****

APPLICATION: 1D-1 Animal Stages
Page T-122/S-70 Human Stages (25-30 min.)

PURPOSE: Apply the concept of life stages and their adaptations to people.

ADVANCE PREPARATION: Materials - none.

Language Cards/Key Signs
human stages
infant stages
child stage
adult stage
elderly stage

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson by asking the children to read the first paragraph on page 70. Teacher may paraphrase.

2. Ask the class to describe how human life stages differ from those of butterflies and frogs. (Butterflies and frogs change a lot from one stage to another, people change very little.)

3. Have the students read through the lesson, view the pictures, and answer the questions. It may be helpful to record the first italicized question as follows: "How does a human spend most of its time during each stage, infant, child, adult and elderly?"

4. Let the students share their responses as they work.

5. Discuss the lesson with the students when they have completed their work. Encourage the students who have babies in their families to describe the babies' behavior. Also, ask them to describe things they do to help the babies. Have students describe how they have helped people older than themselves and how those people have helped them.

DESIRED LEARNING OUTCOME: Ability to describe different life stages of people and tell how behaviors at each stage are adaptations.

****

EVALUATION: 1D-1 Animal Stages
Page T-123/S-71 Living in Stages (40-45 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Naming the adaptations of the adult stage of a given organism.
2. Explaining how a mobile life stage helps a sedentary animal population.
3. Identifying behavioral adaptations unique to grown animals and describing how it helps a population.
4. Comparing the life stages of 2 given organisms.

TEACHING SUGGESTIONS:

1. Have the students turn to page 71 and read through the lesson. Teacher may paraphrase text or questions.
2. Have the students proceed with the lesson when you are certain that they understand what they are to do.
3. Go over the responses with the students when they have completed their work.
4. Let the students correct their own papers, if you wish.
5. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of each question, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 1 Adaptations

Part D Adaptations of Life Stages, Lesson Cluster 1D-2

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-128	Introduction	Stages of Pine Trees	40-45 min.
T-130	Development	Seed Adaptations	*45-50 min.
T-132	Development	Flower Adaptations	*50 min.
T-135	Application	Scattering Seeds	35-40 min.
T-136	Evaluation	Stages in Plant Growth	35-40 min.

*These lessons may be done in 2 parts. See Advance Preparations.

B. MATERIALS: All the items included on Materials List page T-125 plus pine cones.

FILMSTRIP INFORMATION: Filmstrip Set X, Structural Systems, and XVII, Adaptations, are appropriate for use in this unit.

INTRODUCTION: 1D-2 Plant Stages
Page T-128/S-72 Stages of Pine Trees (40-45 min.)

PURPOSE: Introduce the concept that plants as well as animals go through stages as they grow and that full-grown plants have adaptations that allow them to reproduce.

ADVANCE PREPARATION: Material - several fresh pine twigs and pine cones

If possible plan a walk in the woods or a park so that the children can make first hand observations of pine trees in their natural environment. During outdoor walk help students to identify pine trees and cones. Look for a young tree and let the students examine it, making special note of its flexibility. Compare young and old trees by discussing how they are the same and different. Make special note of the trees' trunks and bark as it is discussed in text.

Language Cards/Key Signs
stages
plants
pine tree
pine cones
bark
trunk

Identification Cards
pine cones
pine twigs
(use as labels for display)

TEACHING SUGGESTIONS:

1. After returning to the classroom have the students read the first paragraph on page 72.

2. Explain to the students that in this cluster they will be learning about life stages in plants. In this lesson they will be learning about one plant, the pine tree. Remind them of the pine trees they observed during their walk. Also have them examine the pictures on page 72.

3. Have the students read the remainder of page 72 and answer the italicized questions. Try to relate the questions and text to the nature walk as much as possible.

4. Discuss the page with the students. Explain to them that pine trees need more sun than oaks or beeches.

5. Circulate pine twigs among the students, if you were able to obtain them. Encourage the students to bend the twigs. Explain to them that the twigs are flexible like the trunk of a young tree.

6. Have the students read page 73 and answer all the italicized questions.

7. Discuss the italicized questions with the students. Ask the students how they could tell the age of a pine tree if its bottom branches were gone. (Count the circles of scars as well as branches). You may also want to discuss growth rings in branches with the students. Explain that they are evidence of the tree's response to the environment (rapid growth in the spring; slow growth in the winter).

8. Point out to the students that the kind of pine tree shown lives about 50 years and grows quite large.

9. Explain to the students that as a pine cone matures, it turns brown, its layers open, and the seeds are blown out. By the time that the cone reaches the ground, all of its seeds have dispersed. Most of the seeds do not sprout because they are eaten or they rot.

10. Ask the students if pine cones help the parent tree or the population (population).

11. Have the students respond to and discuss the numbered questions. Teacher may paraphrase.

12. Ask the students to compare the life stages of plants and animals.

DESIRED LEARNING OUTCOME: Ability to describe the life stages of a pine tree and describe adaptations of each stage.

****

DEVELOPMENT: 1D-2 Plant Stages
Page T-130/S-74 Seed Adaptations (45-50 min.)

PURPOSE: Develop the concept of the first life stages of some plants by observing the adaptations of seeds and germinating seeds.

ADVANCE PREPARATION: Materials - Have the following for each student:
- 2 bean seeds which have been soaked overnight
- 2 bean seeds, dry
- 1 pea seed which has been soaked overnight
- 1 pea seed, dry
- 1 paper cup
- 1 cup of soil
- 2 sheets of unlined paper, pencil and crayons
- 1 metric ruler

Language Cards/Key Signs
adaptations
seed
sprout
soaked
bean seed
pea seed

Identification Cards
(Make labels for the above words)

You may want to teach this lesson over a two day period doing page 74 one day and 75 the next day. It is best if page 75 is begun on a Friday afternoon, so that the students will be able to dig up a seed on each of five consecutive days. You may then on Monday, plant two more cups of seeds so that the students can dig them up on Tuesday and Wednesday, simulating what may have happened to the original seeds on Saturday and Sunday. Soak half of the bean seeds and half of the pea seeds the night before the lesson.

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students read the first paragraph on page 74. Teacher may paraphrase the text. If the students have done lesson (3a) in the previous cluster, ask them how a chicken egg and a seed are alike (first stage of life, small organisms surrounded by stored food, protective cover).

2. Distribute to each student one dry pea and bean seed and one soaked pea and bean seed.

3. Have the students read through the directions for the activity on page 74. Teacher may paraphrase.

4. Discuss the directions with the students making sure that they understand what they are to do.

5. Have the students do the activity.

6. Encourage the students to compare their seeds.

7. Ask the students how they can tell that the tiny plant does not make its own food (not green, grows in darkness). Ask them how the seed cover is an adaptation. (Protects tiny plant and its food.)

   -- At this point the lesson may end and be resumed on the next day.--

8. Have the students read the directions for the second part of the lesson page 75. Teacher may paraphrase text.

9. Discuss the directions with the students. Explain that they are to plant three seeds in each cup so that they can dig up another seed if one seed doesn't sprout. Before planting the seeds, the students should poke small holes in the bottom of each cup for drainage. They should keep the seeds damp, not soaked. The cups of soil should not be allowed to sit in water.

10. Divide the students into groups of 2 and have them do the activity. Use the identification card to label the plants while on display.

11. Provide a period each day at the same time for the students to dig up a sprout, draw it, and record its length. After five days you may want to have the students compare a soaked seed, a sprout, and a full grown plant.

12. Have the students read the remainder of the lesson and answer the questions.

13. Discuss the lesson with the students. Remind them of seed response to gravity (Cluster C-2). In discussing question 4, explain that seed companies provide necessary dormant periods for seeds before selling them so it is unnecessary to refrigerate them before planting.

14. Explain to the students that some kinds of plants live for only one summer. Ask them where new plants of the same kind come from next spring (seeds).

DESIRED LEARNING OUTCOME: Ability to describe the structures of a bean and pea seed and describe their adaptations, and describe changes in sprouting bean seeds.

****

DEVELOPMENT: 1D-2 Plant Stages
Page T-132/S-76 Flower Adaptations (50 min.)

PURPOSE: Extend the concept of life stages of plants.

ADVANCE PREPARATION: Materials - 2 sheets of unlined paper
- scissors
- crayons and a pencil for each student

Obtain some large flowers to dissect having both stamens and a pistil. Avoid getting a compound flower, such as a daisy. Tulips and gladioli are good to work with. Often you can obtain wilted flowers from a florist free of charge. If this is not possible use the pictures in the text as examples. If this approach is taken an opaque projector may be used to project and enlarge the image of the flower for use during discussion.

Language Cards/Key Signs

flower
reproduce
sepals
petals
stamens
pistil
eggs
pollen tube
fruits
pollen grains
pollen
nectar
wind-carried

Identification Cards

TEACHING SUGGESTIONS:

---You may wish to do this lesson in two days. Pages 76 and 77 may be taught one day and page 78 the next day.

1. Introduce the lesson by asking the students if they think flowers could be adaptations and why or why not. Allow this question to remain open ended.

2. Have the students read the introduction to the lesson on page 76. Teacher may paraphrase text.

3. Write the terms sepal, petal, stamen, and pistil on the chalkboard. Explain to them that they will be learning their meanings as they examine flowers.

4. Distribute the materials to the students.

5. Ask the students to read the rest of page 76 and all of page 77. Teacher may paraphrase. Use the pictures in the text as illustrations of each flower part and if real flowers are also being used. Explain to them that they should follow the directions and answer the questions.

6. Move around the room making sure that the students can successfully identify the parts of their flowers. Show students how to cut a pistil lengthwise for cross section. Teacher demonstration of the process may be helpful.

7. Collect the materials when the students have completed this part of the activity.

8. Discuss the function of a flower and term fruit with the students. The word fruit is used here in a biological sense, not in a common sense. Explain to the students that nuts with seeds inside are fruits, as are corn kernels and many grains. Also mention that many fruits, such as burrs, are not eaten at all.

--At this point the lesson may end and be resumed the following day.--

9. Have the students read page 78 and answer all the questions. Teacher may paraphrase.

10. Explain to the students that pollen must fall on the pistil of a flower of the same kind for interaction to take place.

DESIRED LEARNING OUTCOME: Identify the major parts of a flower, describe how eggs and pollen interact, and tell how pollen is carried to a pistil.

****

APPLICATION: 1D-2 Plant Stages
Page T-135/S-79 Scattering Seeds (35-40 min.)

PURPOSE: Develop the concept that adaptations for the dispersal of seeds help the population rather than the individual parent plant.

ADVANCE PREPARATION: Materials - none.

Language Cards/Key Signs
sprouts
scatter
wings
parachutes
burrs
structures

Identification Cards

TEACHING SUGGESTIONS:

1. Begin this lesson by having the students read the introduction to the lesson on page 79. Teacher may paraphrase text.

2. Explain to the students that they will be learning about some structures that help scatter seeds.

3. Have the students read the lesson paying special attention to the pictures. Answer the italicized questions.

4. Let the students share their responses as they work.

5. Move around the room providing help as it is needed.

6. Discuss the lesson with the students when they have completed their work. Explain to them that the color of a fruit might be an adaptation because animals are attracted to the fruit by its bright color. Further explain that fruits that float sometimes help scatter seeds. The coconut is one of these fruits. Plants with these fruits usually live near water.

7. Have the students respond to and discuss the numbered questions.

DESIRED LEARNING OUTCOME: Ability to identify structures for seed scattering as adaptations.

* * *

EVALUATION: 1D-2 Plant Stages
Page T-136/S-80 Stages in Plant Growth (35-40 min.)

PURPOSE: To evaluate the students' performance in reference to the following objectives:

1. Identifying the functions of a given scattering behavior of fruit.
2. Naming the plant structures of pine whose functions are reproducing and describing their functions.
3. Naming environmental factors that keep seeds from sprouting.
4. Telling whether a flower has a wind carrying pollen or insect carried pollen and explaining how they know.
5. Describing how certain seeds are scattered and explaining how they know.

TEACHING SUGGESTIONS:

1. Have the students turn to page 80 and read the lesson. Teacher may paraphrase the text.

2. Have the students proceed with the lesson when you are certain that they understand what they are to do.

3. Go over the responses with the students when they have completed their work.

4. Let the students correct their own papers, if you wish.

5. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next unit.

6. For further informal evaluation, have the students turn back to page 62 to look at the picture that introduces Part D. Ask them why they think that particular picture was used to introduce the part that was just completed. Suggest that they look for clues in the part title and in the cluster titles on page 63 and 72. The students should be able to:
   a. identify young and old life stage of oppossums;
   b. identify the behavior of a female adult oppossum carrying young oppossums on its back as an adaptation that helps the population rather than the individual parent;
   c. identify the behavior of young oppossums clinging to the adult oppossum as an adaptation that helps the young oppossums get help from the parent;
   d. identify the adult oppossum's tail as an adaptation that helps the oppossum stay in one place;
   e. identify an acorn as the first life stage of an oak tree;
   f. identify an acorn producing tree as the last life stage of an oak tree.

* * *

Level 5 Unit 2 Forces

Part A Forces in Action, Lesson Cluster 2A-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-148	Introduction	What is a Force?	30-35 min.
T-146	Introduction	Energy Causes Changes	30-35 min.
T-150	Development	Balanced Forces	20-25 min.
T-151	Development	An Introduction Game	30-35 min.
T-152	Development	Three-Way Tug of War	30-35 min.
T-154	Application	Showing Forces	30-35 min.
T-156	Evaluation	Understanding Forces	30-35 min.

NOTE: What is a Force? has been made the first lesson so that children will concretely experience the concept before reading about it in Energy Causes Changes.

B. MATERIALS: Add the following to the list on page T-143:
- objects to demonstrate force as push or pull, i.e., books, furniture blocks, etc.
- golf club and ball, bat and ball/and or pencil and marble
- "rope triangles" and "rope/yarn circles" see Advanced Preparation for Three-Way Tug of War

FILMSTRIP INFORMATION: Filmstrip Set XVI, Pushes and Pulls, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2A-1 Identifying Forces
Page T-148/S-84 What is a Force? (30-35 min.)

PURPOSE: Introduce the concept of force.

ADVANCE PREPARATION: Materials - objects in the classroom used to demonstrate that force is a push or pull. These can be anything that can be pushed or pulled, i.e., books, furniture, blocks, chalk, etc.

Language Cards/Key Signs
force
push
pull

SAFETY ALERT: Caution the students against trying to push or pull objects that are big or heavy. Explain to them that they could seriously injure themselves.

TEACHING SUGGESTIONS:

1. Have the students turn to page 84 and read the introduction to the lesson to find out what a force is. Teacher may paraphrase.

2. Be sure the students understand that a force may be either a push or a pull.

3. Ask the students what evidence they might observe as the result of a push or pull. They will probably name movement of an object as the evidence. Emphasize however, that sometimes when a force is applied to a system, nothing moves.

4. Demonstrate some examples of force using objects in the classroom. Ask the students to demonstrate examples on their own.

5. Have the students do the rest of page 84 and 85 up to the numbered questions. Teacher may paraphrase. Provide sufficient time for them to enjoy the pictures as well as answer the questions.

6. Discuss the italicized questions with the students. Be sure that they base their answers on evidence that they can see in or infer from the pictures.

7. Have the students give examples of pushes and pulls that they have used to make objects move. They may think of such examples as pushing a lawn mower or vacuum cleaner, pulling a rope to raise a flag on a pole, or pushing on the pedals of a bicycle.

8. Ask the students if they have ever tried to move something by pushing or pulling only to find that it would not move no matter how hard they tried. Have the students describe such situations and then explain why they think the objects would not move. They may give such examples as trying to make a dog or a cat go out when it is raining, trying to move a large rock, or two persons trying to get a ball away when they catch it at the same time. The students will probably explain that whatever would not move was stronger than they are.

9. Ask the students if they think that the rock between the two tractors in picture B is doing any pushing or pulling (yes). Then ask what they think would happen if the rock were changed to an orange crate (The crate would collapse, and the tractors would collide.)

10. Have the students look again at the picture on page 85. Make certain they realize that the donkey is exerting great force. Ask them if they think that the task of the students in the picture would be easier if the donkey were changed to a box that weighed just as much (Yes. Because a box could not resist.)

11. Discuss the numbered questions with the class.

12. Conclude the lesson by making certain that the students understand what a force is. Have them now look at the picture of the golfer on page 83 to identify the force that was involved when energy was transferred from the golf club to the ball (The club "pushed" the ball.)

DESIRED LEARNING OUTCOME: Ability to identify and describe forces in terms of pushes and pulls.

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INTRODUCTION: Lesson Cluster 2A-1 Identifying Forces
Page T-146/S-83 Energy Causes Changes (30-35 min.)

PURPOSE: Review or introduce the terms interaction, system and evidence and the concepts of energy and energy transfer.

ADVANCED PREPARATION: Materials - Objects which can be used to demonstrate that energy causes change. For example:

- golf club and ball
- bat and ball
- pencil and marble

Language Cards / Key Signs

energy
interact
energy transfer
system
evidence

TEACHING SUGGESTIONS:

1. Write the terms interaction, system and evidence on the chalkboard. Make certain that the students understand that interaction is what takes place when objects do something to each other, that a system is a group of objects that have interacted, are interacting, or could interact, and that observable clues are evidence.

2. Demonstrate these concepts with objects on hand.

3. Explain that changes in the properties of one or more objects in a system take place when the objects interact. These changes are evidence of interaction.

4. Use the picture of the golfer hitting the golf ball on page 83 to make certain that students understand the terms. Have the students identify the ball and the golf club as the objects in the system that interacted. Have them describe the change in the property of the ball (change in position from the golf tee to where it is in the picture) as evidence that interaction has happened.

5. Have the students read the first paragraph on page 83 to find out what energy is and how it can affect interacting objects. Teacher may paraphrase.

6. Write the terms energy, energy transfer, and evidence in a horizontal line on the chalkboard while the students read. (Leave the terms on the board for use later in the lesson.)

7. Emphasize that energy is needed to make objects in a system interact and that the passage of energy through a system is called energy transfer.

8. Have the students review forms of energy that can transfer through a system (light, sound, heat, electricity, and motion). Write the list on the chalkboard under the heading Forms of Energy. If the students are new to the program, provide the list for them. (Leave the list on the board for use later in the lesson.)

9. Explain to the students that a change in an object is evidence of energy transfer. Then ask them to name the change resulting from energy transfer that they read about (change in movement).

10. Have the students read the second part of the lesson and answer the italicized questions.

11. Write "hit golf ball" under energy transfer on the board and "ball moves" under evidence.

12. Have the students read what you have written on the board. Then write "hit baseball" under energy transfer. Ask the students what you should write under evidence (ball moves).

13. Write "catch a baseball" in the first list and ask the students what should be written in the second list (ball stops). The students will probably know that the ball stops, but may have difficulty in understanding that a ball stopping is a change in movement of the ball and evidence of energy transfer.

14. Have the students discuss the numbered question. Refer the students to the list of forms of energy on the board and explain that they may use the various forms in the examples that they give.

15. Add the descriptions of and the evidence for energy transfers that the students think of to the lists already on the board. If they have difficulty starting, help them get started by writing "cook food" under energy transfer and "food changes color" or "food changes temperature" under evidence. Point out that evidence of heat transferring through a food-cooking system is a change of color, temperature, or texture, not a change in movement.

16. Conclude the lesson when you are sure that the students understand evidence of energy transfer.

DESIRED LEARNING OUTCOME: Ability to give examples of energy transfer & describe changes that result as evidence of the transfer.

****

DEVELOPMENT: Lesson Cluster 2A-1 Identifying Forces
Page T-150/S-86 Balanced Forces (20-25 min.)

PURPOSE: To extend the concept of forces to the study of balanced forces.

ADVANCED PREPARATION:

Background Information - When forces that are acting against each other are of the same amount, they are called balanced forces. Balanced forces produce no motion or change in motion. Pushing against a wall is an example of balanced forces. You exert a force on the wall and the wall exerts a force back on you. Because the forces are balanced, the wall does not move.

TEACHING SUGGESTIONS:

Language Cards/ Key Signs
balanced forces
movement

1. Introduce the lesson by having the students read the first two paragraphs on page 86 to find out what balanced forces are. Teacher may paraphrase.

2. Be sure that the students understand that forces are balanced when two objects exert a force (a push or a pull) against each other, but do not move. Demonstrate the concept by pushing against the wall or any other heavy object that will not move. Ask the students for other examples.

3. Have the students continue with the lesson as far as the numbered questions. Let them discuss the pictures with their neighbors as they work.

4. Discuss the italicized questions with the class. In responding to the questions, be sure that the students describe the evidence in the pictures on which they based their answers.

5. Ask the students to turn back to pages 84 and 85 and determine whether the forces are balanced or unbalanced in each of the pictures (They are all balanced).

6. Have the students discuss the numbered questions. For question 2, it is unnecessary to discuss the forces involved at this time.

7. Conclude the lesson by emphasizing that balanced forces, usually the result of pushes and pulls in opposite directions, cause no motion or change in motion.

DESIRED LEARNING OUTCOME: Ability to describe balanced forces in terms of physical pushes and pulls in opposite directions that cause neither motion nor change in motion.

****

DEVELOPMENT: Lesson Cluster 2A-1 Identifying Forces
Page T-151/S-87 An Interaction Game (30-35 min.)

PURPOSE: Extend the concept of force to the changing of balanced forces to unbalanced forces.

ADVANCED PREPARATION: Materials - none.

Language Cards/Key Signs
interaction
balanced
unbalanced

TEACHING SUGGESTIONS:

1. Have the students read the introduction to the lesson on page 87 to review the difference between forces that are balanced and those that are unbalanced. Teacher may paraphrase.

2. Explain to the students that they are going to play a game based on balanced and unbalanced forces.

3. Have the students read the rest of the first column to find out how to play the game.

4. Go over the directions for the game when the students have finished reading. Make certain that they understand what they are to do. Have them look at the pictures to see how to place their hands and feet.

5. Divide the students into pairs. Try to match the pairs as closely as possible by size.

6. Have the students play the game. After a while, remind the students to change the game according to the directions on page 87. They will probably soon discover that the changes in the game can result in unbalanced forces that cause one of the partners to move.

7. Circulate among the students to determine if anyone has discovered how to win the game by deliberately changing the amount of force that he or she exerts against the hand of a partner. If the students have not discovered the strategy, suggest to one of them that he or she push just hard enough to balance forces and then suddenly stop pushing.

8. Provide time for the rest of the class to play the game by changing balanced forces to unbalanced forces. Caution the students against pushing against another person's hand as hard as they can and then suddenly releasing the force. This could cause a student fall and get hurt. Explain that, to begin, they must push hard enough to balance forces.

9. Discuss the numbered questions with the class. Use question 3 to stress the point that people can control and manipulate force.

DESIRED LEARNING OUTCOME: Ability to describe at least one way to change balanced forces that produce no motion to unbalanced forces that cause motion.

****

DEVELOPMENT: Lesson Cluster 2A-1 Identifying Forces
Page T-152/S-88 Three-Way Tug of War (30-35 min.)

PURPOSE: Extend what has been learned about forces to the achievement of balanced or unbalanced forces by changes in the amount of force exerted.

ADVANCED PREPARATION: Materials - Make a "rope triangle" for every three children. This may be done by tying the 2 ends of a piece of rope (about 3 ft. long) together. As each of the 3 children hold a section of the circle and pull a triangle is made. Also make a large circle of rope or yarn for every 3 children. It should be large enough for 3 children to stand in and play Three-Way Tug of War. See page 88 in Text.

Language Cards/Key Signs
balanced
unbalanced

TEACHING SUGGESTIONS:

1. Have the students turn to page 88.

2. Explain to them that they are going to learn about a different kind of interaction game.

3. Have the students do the whole lesson. Instead of only looking at the pictures the students should actually do the activity.

4. Discuss the questions with the students when they have finished. Be sure that they give reasons for their answers. (The multiple-choice question at the end of the lesson replaces the usual numbered questions.)

5. Ask the students what happened when they pushed harder or decreased the force that they were exerting in the Interaction Game (Forces became unbalanced).

6. Ask the students how the game described on page 88 differs from the one that they played (Two people can combine their "forces" to win the game on page 88).

7. Have the students again look at the picture on page 85. Point out that two students are trying to push the donkey from behind. Ask the students if they think the donkey is pushing back. If some students say that the donkey "is just sitting there," point out that the donkey is digging in its hooves to oppose motion.

8. Explain to the students that nonliving objects can push or exert force. If someone pushes against a wall, the wall balances the person's force and no motion results. In effect, the wall pushed back.

9. Ask the students if they have ever felt a lawn mower or vacuum cleaner "push back." Have them name other nonliving objects that "push back."

DESIRED LEARNING OUTCOME: Ability to give an example of how a balanced force can be changed to an unbalanced force by changing the amount of force that is exerted.

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APPLICATION: Lesson Cluster 2A-1 Identifying Forces
Page T-154/S-89 Showing Forces (30-35 min.)

PURPOSE: Apply what has been learned about forces to everyday situations and to use arrows to indicate the strength and direction of forces.

ADVANCED PREPARATION: Materials - paper and pencil for each student.

Language Cards/Key Signs
force
direction

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to name some way in which they use forces. They will probably name such ways as closing doors, moving chairs, pushing someone on a swing, or seesawing.

2. Ask the students to distinguish between situations in which they have to think about how much force to use and those in which they use force without having to think about it. They will probably say that they have to think about force when they try to open a window that is stuck, push someone on a swing, or hammer a nail into a board. They will probably say that they do not think about force when they open a door or carry a book.

3. Explain to the students that the lesson they are going to do is about forces in every day situations. Further explain that they will learn how to represent forces with arrows.

4. Have the students turn to page 89 and do the lesson up to the numbered questions on page 90. Teacher may paraphrase.

5. Distribute the paper and pencils while the students read.

6. Discuss the italicized questions with the students.

7. Ask the students why they think that the arrow in picture B is pointing in the direction it is. (The direction of the arrow is in the direction of the force.)

8. Ask the students to sketch a picture on their papers that shows the same girl pushing the sled uphill. Explain that stick figures may be used in the drawings to save time.

9. Have the students add an arrow to their pictures to show the direction of the force. (The arrow should be drawn in the opposite direction). Help the students to understand that the sled is pulling back in picture B and pushing back in the picture that they draw.

10. Discuss the numbered questions with the students.

11. Ask the students to draw pictures of some every day situations in which they use forces. Suggest that they illustrate some of the examples they thought of at the beginning of the lesson (See Teaching Suggestions 1 and 2). Have the students use arrows to show the direction and strength of the forces in their pictures.

12. Collect the pictures when the students have finished them. Be sure that their names are on their papers.

13. Tell the students that you are going to pin up the pictures on the bulletin board later on. During their free time they are to look at the pictures. They are to try to figure out the strength and direction of the forces in each picture from the arrows.

14. Provide time for the students to discuss the pictures on the bulletin board after most of them have had an opportunity to look at them.

DESIRED LEARNING OUTCOME: Ability to give examples of how they use forces in everyday situations and to make their own simple illustrations, or interpret the illustrations of others, in which arrows are used to represent the strength and direction of a force.

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EVALUATION: Lesson Cluster 2A-1 Identifying Forces
Page T-156/S-91 Understanding Forces (30-35 min.)

PURPOSE: To evaluate the student's understanding and performance in relation to the following objective:

1. Drawing arrows to illustrate the direction and amount of forces.

ADVANCE PREPARATION: Materials - paper and pencils

TEACHING SUGGESTIONS:

1. Have the students turn to page 91 and read through the lesson.

2. Be certain that they understand what they are to do. In order to clarify the directions refer to pages 89 and 90 and review how the arrows were used to show force direction.

3. Have them do the lesson.

4. Go over the students' reponses with them when they have completed the work. You may want to let them correct their own papers so that they may evaluate their own progress.

5. Collect the papers so that you may evaluate each individual's progress. If a student correctly draws arrows to illustrate the direction and strength of at least four of the forces, you may assume that he or she has mastered the objective for this cluster and is ready to go on to the next cluster.

Level 5 Unit 2 Forces

Part A Forces in Action, Lesson Cluster 2A-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-162	Introduction	A Force Measurer	35-40 min.
T-164	Development	Units for Your Measurer	35-40 min.
T-166	Development	Using your Measurer	35-40 min.
T-168	Development	Checking your Measurer	35-40 min.
T-169	Development	Using a Spring Scale	35-40 min.
T-170	Development	Weight is Force	25 min.
T-171	Development	Comparing Scales	30-35 min.
T-172	Development	Combining Scales	40 min.
T-173	Application	Everyday Scales	30 min.
T-174	Evaluation	Weighing In	35-40 min.

B. MATERIALS: Add the following to the Materials List on page T-159:
- 1 thermometer
- 1 ruler
- 1 coat hanger, preferrably wooden

FILMSTRIP INFORMATION: Filmstrip Set XVI, Pushes and Pulls is appropriate for use in this unit.

INTRODUCTION: 2A-2 Measuring Forces
Page T-162/S-92 A Force Measurer (35-40 min.)

PURPOSE: Introduce the measurement of forces by having the students make a simple force measurer.

ADVANCE PREPARATION: Materials - have enough of the following for each pair of students:
- 3 index cards
- 1 jumbo paper clip
- 1 scissors
- 1 rubber band

Also have on hand several:
- staplers
- paper punches
- small objects from the classroom, i.e., erasers, pencils, etc.
- 1 piece of string (30 cm or 12 in.) for each student

Language Cards/Key Signs
force measurer

You may either staple the file cards together in sets of three before class or have the students do it during class. The measurers work best when they are made from three file cards.

It is recommended that you use one of the following brands of rubber bands: Plymouth 33, B.F. Goodrich 19, or Revere 16. If these are not available, you will have to pretest bands to be sure that there is sufficient stretch in them when light objects are hung on the clip. Rubber bands do not stretch evenly. For example, when three objects are added, the amount of stretch will be greater than the sum of the three separately.

Although most paper clips will work as hooks, jumbo clips are recommended so that the students can weigh a variety of objects. The students may have difficulty if the paper-clip hook does not weigh enough to pull the rubber band straight. It helps if the rubber band is made to hang as straight as possible before the clip is attached to it.

Collect small classroom objects such as erasers, pencils, and blunt scissors that the students may use to find out how their force measurers work.

Cut pieces of string 30 cm (12 in.) long for the students to use to hang objects on their force measurers. They will have to tie an object to one end of a string and tie the other end of the string to the paper clip. Place all the materials on a centrally-located table.

TEACHING SUGGESTIONS:

1. Have the students turn to page 92 and read the title of the second cluster. Explain to them that the amount of a force can be measured. They are going to make measurers to measure forces themselves.

2. Divide the students into groups of 2.

3. Have the students read the lesson as far as the numbered questions to find out how they are going to make force measurers. Teacher may paraphrase.

4. Distribute the file cards, rubber bands, paper clips, staplers, and paper punches to the groups as they read.

5. Explain to the students that these are the materials they will need to make their force measurers.

6. Have the students do the lesson when you are sure that they understand what they are to do. Remind them to use the picture on page 92 to help them make their force measurers. Teacher may make his or her own force measurer for demonstration.

7. Help the students, as necessary, to fold and fasten file cards, to adjust rubber bands so that they hang straight and to "bend open" paper clips.

8. Explain to the students that they are now going to find out how to use their force measurers. Point out where you have put the objects and strings that they are to use.

9. Hold up the different objects that you have collected and explain that each group will need three objects and three strings.

10. Explain to the students that they are to test their measurers with one object, then two objects, and then three objects.

11. Demonstrate how to tie one end of a string to an object and then how to tie the other end of the string to a paper clip. Using a different string, also show them how to tie two objects to the string.

12. Tell the students that they should always hold their measurers at the top so that the cards will remain straight when they hang objects on them.

13. Have one member of each group go to the supply table to choose three objects to test and three pieces of string.

14. Have the students discuss the numbered questions.

15. Ask the students in each group to write their names on their force measurers.

16. Store the measurers in a safe place because they will be used in several of the lessons that follow this one.

DESIRED LEARNING OUTCOME: Ability to construct a simple force measurer and observe that its rubber band stretches more when objects are attached to it.

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DEVELOPMENT: 2A-2 Measuring Forces
Page T-164/S-93 Units for Your Measure (35-40 min.)

PURPOSE: Use washers as arbitrary units to make a scale for the force measurer.

ADVANCE PREPARATION: Materials - Have the following for each pair of students:
- 8 washers, metal, 4.5 cm (1 3/4 in.) outside diameter
- the Force Measurer from previous lesson

Also have on hand:
- 1 thermometer
- several rubber bands
- 1 ruler

Language Cards/Key Signs
units
force
washer

Collect the washers and place them with the students' force measurers and the rubber bands that you previously collected on a centrally-located supply table. Each group of three students will need eight washers. The rubber bands are to replace those on the force measurers that may break.

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that they are going to add scales to their force measurers. They will then be able to measure amounts of force that objects hung on them exert.

2. Have the students look up the term scale in the Glossary. If the term is new to them, give them examples of scaled instruments, such as a Celsius thermometer or metric ruler. Illustrate using a thermometer and/or ruler.

3. Divide the class into the same groups of 2 that worked together in the lesson, A Force Measurer, on page 92.

4. Have the students turn to page 93 and read the introductory paragraph to find out what units they are going to use to make scales for their force measurers. Teachers may paraphrase.

5. Remind the students, when they have finished reading, that they probably used arbitrary units such as paper clips when they first learned to measure length. They will use washers to learn how to measure forces.

6. Have the students read the rest of page 93 to find out how they are going to add a washer-unit scale to their force measurers.

7. Go over the directions with the students when they have finished reading. Emphasize that the "washer units" are to be added to their measurers one at a time. After each washer is added, they are to mark how much the rubber band is pulled down.

8. Have the students look at the pictures on page 93 to see how the "washer unit" scale will look.

9. Point out that in picture A the line at the top of the paper clip has a zero next to it to show that no force is applied when the measurer hangs with nothing attached to it.

10. Point out that in Picture B one washer unit has been hung on the measurer. The mark "1W" has been written next to the top of the paper clip to show the downward force of one washer.

11. Caution the students always to mark the units at the top of the clip, where it is attached to the rubber band.

12. Explain to the students that one member of each group should hold the card, the second member should hold the clip in place when each line is marked, and the third member should mark the card.

13. Pass out the force measurers and washers to each group. Point out where you have put the extra rubber bands to replace any on the force measurers that break.

14. Have the students mark their measurers.

15. Remind the students to take the washers off the paper clip, to add them again, one at a time, and to mark their scales each time.

16. Have the students discuss the italicized question.

17. Ask the students to turn to page 94, read the directions in the first paragraph, and then add washers to their measurers three or four more times.

18. Review or introduce the term range before going further. Explain that the marks that they made on their force measurers show the range of readings for each washer. Further explain that the "midpoint" of the range is the point that best represents the range of readings for each load of washers.

19. Have the students read the rest of page 94 as far as they numbered questions and then draw boxes around their sets of lines. Have the group members take turns marking the midpoints of the boxes. The students may experience some difficulty in drawing boxes and marking lines for the midpoints for the first one to three "washer" units because there will not be much distance between the units.

20. Discuss the numbered question with the students. Point out to the students that their measurers do repeat measurements accurately within a certain range. No measuring instruments, however, give precisely the same result each time, no matter how accurate the instrument may be.

21. Store the students' force measurers where they will be readily available for use in the next lesson.

DESIRED LEARNING OUTCOME: Ability to make scales for their force measurers and explain why the readings vary within a certain range.

****

DEVELOPMENT: 2A-2 Measuring Forces
Page T-166/S-95 Using Your Measurer (35-40 min.)

PURPOSE: Extend what has been learned about force measurers to the measurement of the downward force of familiar objects. This lesson may be correlated with a math lesson or decimals.

PREREQUISITES: Ability to estimate distance between two points and express the estimate in fraction and decimal form.

ADVANCE PREPARATION:

Language Cards
downward force
washer units
decimal

Background Information - Decimals are introduced in this lesson and are used throughout the rest of this unit. Usually fifth level students know how to use simple decimals. Because decimals are not taught in some school systems until after fifth grade, decimals are related to fractions when they are introduced.

If the students have not yet studied decimals, you may want to explain decimals to them before they do this lesson. If the students are familiar with decimals you may want to conduct a brief review.

Materials - For each pair of students you will need:
- 1 scissors
- 1 Force Measurer
- 1 roll of tape, to test downward force
- 1 small, spiral notebook

Also, each student will need.
- 1 pencil
- paper

Collect the scissors, rolls of tape, and notebooks. If you are unable to obtain these objects, or sufficient quantities of them, it is all right to substitute such objects as small pencil sharpeners, pencil cases, spoons, or other available objects. Each group of students should have three objects to use.

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that they are going to compare the downward force, or pull, of different objects on their force measurers.

2. Divide the class into the same groups of 2 that worked together in the last two lessons.

3. Have the students turn to page 95 and read the first column as far as the next to last paragraph to find out how to make the chart that they will need. Teacher may paraphrase.

5. Distribute three objects to each group while they work.

6. Have the students measure and record the downward force of the objects that you have given them. Let them share their observations as they work.

7. Ask the students if all the forces come out exactly on "washer" units.

8. Ask the students to read the rest of column one and the first paragraph at the top of the column two to find out how they are going to record the downward forces of the objects that they have listed on their charts.

9. Direct the students' attention to the picture. Explain that if the measurement of the force of an object falls between two units, they will have to estimate or try to figure out just how far the object is between the marks. Explain that they are to imagine ten equal spaces between each pair of units. If the objects hangs halfway between, they can estimate the distance as 5 of the 10 spaces, or 5/10.

10. Review or introduce the term decimal. Write the term on the chalkboard.

11. Write the fraction 5/10 on the chalkboard. Beside it write 0.5 and explain that this is how five-tenths is written as a decimal. Write the fractions 3/20 and 7/10 on the chalkboard and ask the students to tell you how to write the fractions in decimal form.

12. Have the students again measure the downward force of their objects. This time, they are to record forces in decimals.

13. Discuss the charts with the students when they have completed them. Have the groups that used similar objects compare their results.

14. Discuss the numbered questions with the students.

DESIRED LEARNING OUTCOME: Ability to measure the downward force of 3 objects and estimate and record scale readings that fall between units in decimals.

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DEVELOPMENT: 2A-2 Measuring Forces
Page T-168/S-96 Checking Your Measurer (35-40 min.)

PURPOSE: Determine how evenly a rubber band stretches in a force measurer.

PREREQUISITES: Ability to measure with a ruler.

ADVANCE PREPARATION:
Background Information - Rubber bands stretch unevenly. The students probably noted earlier that the amount of stretch between units greatly increased as they added more washers to their force measurers. Eventually, the bands stretch out of shape, lose their elasticity, and break. Because of this, rubber-band scales are neither accurate nor reliable. The questions at the end of the lesson help the students to reach this conclusion.

Materials: For each pair of students you will need
- 1 Force Measurer
- 2 rulers

Also, for each student have -
- 1 pencil
- paper

TEACHING SUGGESTIONS:

1. Divide the class into the same groups of 2 that have worked together in the previous lessons.

2. Have the students turn to page 96 and read through the lesson as far as the numbered questions to find out what they are going to do. Teachers may paraphrase.

3. Make certain that the students understand that they are to measure the distance between midpoint lines.

4. Pass out the paper, pencils, and rulers and have the students copy the chart and measure and record distances between midpoints on their force measurers.

5. Circulate among the groups providing help as it is needed.

6. Have the students discuss the numbered questions.

7. Ask the students what they think would have happened to the rubber band if they added more washers when they made the scale on their force measurers. (Rubber bands would stretch out of shape, lose their elasticity, and break.) Also ask students if they think that their rubber band measurers would be good for measuring how much a person weights (No, the rubber bands would break).

DESIRED LEARNING OUTCOME: Ability to determine how evenly or unevenly the rubber band stretches on a force measurer.

****

DEVELOPMENT: 2A-2 Measuring Forces
Page T-169/S-97 Using a Spring Scale (35-40 min.)

PURPOSE: Measure forces in newtons on a standardized spring scale.

ADVANCE PREPARATION:

Language Cards/Key Signs
spring scale
newtons

Background Information - In the metric system, newtons are units of force. One newton is equal to 1.224 lb. (4.45N=1 lb.). While a spring scale is far more reliable than a rubber band force measurer, the force measurer is superior in measuring the force of a light object. The spring scale is not sensitive enough to do so.

Materials: Have 1 spring scale and 8 washers for each 2 or 3 students. Also have the following for each student-
- 1 ruler
- 1 pencil
- paper

46-

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that they are now going to use a measurer that is more exact than their rubber band measurers. This measurer uses springs to measure forces.
2. Divide the class into groups of 2-3. Give each group a spring scale. Tell the students that the instrument is called a spring scale.
3. Have the students turn to page 97 and read the first three paragraphs to find out how a spring scale is used. Teacher may paraphrase.
4. Ask the students what scales they have used. They will probably name scales on thermometers and on instruments on which they weigh themselves. Tell the students that measurers are called scales when they have equal distances between the units.
5. Ask each group to look for the spring in the spring scale. Have them pull on the hook of the spring scale and observe what happens to the spring.
6. Ask the students how they think the spring scale is like the force measurer that they made. They will probably say that they both stretch, have numbers, and have hooks on which objects can be hung.
7. Have each student make a chart like the one in the book.
8. Distribute eight washers to each group.
9. Have the groups complete the lesson.
10. Move among the student, providing help as needed.
11. Discuss the numbered question with the students. Be sure the students understand that a spring scale stretches much more evenly than a rubber band and is, therefore, more reliable.

DESIRED LEARNING OUTCOME: Ability to describe a newton as on amount of force and perform simple measurements using a standardized spring scale.

****

DEVELOPMENT: 2A-2 Measuring Forces
Page T-170/S-98 Weight is a Force (25 min.)

PURPOSE: Introduce the concept of gravity and weight as a measurable force.

ADVANCE PREPARATION:

Background Information - There are two main principles that explain gravity. Principal 1 states: Every mass (amount of matter in an object) in the universe attracts every other mass with a force proportional to the product of the masses. The first principle explains why people would weigh less on the moon than on Earth. The mass of the moon is less than the mass of the Earth. In contrast to weight, mass is a constant. It never changes. Weight is relative.

Language Cards/Key Signs
weight
force
gravity

Principle 2 states: Every mass in the universe attracts every other mass with a force inversely proportional to the square of the distance between their centers of gravity. The second principle explains why the force of gravity is less on top of a high mountain than down in a valley. You are farther from the center of the Earth when you are on top of a high mountain. Only precise instruments can detect the small decrease in weight.

Materials: - 1 spring scale and 1 coat hanger for demonstration
- objects in the classroom such as a book, pencil, desk and eraser

TEACHING SUGGESTIONS:

1. Introduce the lesson by writing the term gravity on the chalkboard and asking the students what they know about gravity. They will probably say that it holds them down and makes things drop.

2. Have the students read the introduction on page 98. Teacher may paraphrase.

3. Be sure the students understand that the force of gravity is the pulling force of the Earth. Explain that an object hanging on a spring scale is actually being pulled down by the Earth. Demonstrate the force of gravity by dropping small objects to the floor. Also use spring scale and hanger to demonstrate the example in the book.

4. Ask the students why objects are not always falling to the ground. Students who have studied patterns of support at Level 4, will probably be able to explain that objects have support structures (stems, beams, or legs).

5. Have the students do the rest of page 98.

6. Discuss all of the questions with the students.

DESIRED LEARNING OUTCOME: Ability to describe the force of gravity as the pulling force of the Earth and describe the weight of an object both as a measure of the Earth's pull on the object and the amount of downward force of the object when it hangs on a spring scale.

****

DEVELOPMENT: 2A-2 Measuring Forces
Page T-171/S-99 Comparing Scales (30-35 min.)

PURPOSE: Extend what has been learned about scales to the comparison of the readings of 2 spring scales.

ADVANCE PREPARATION: Materials - 2 spring scales for each 2 students

Language Cards / Key Signs
compare

TEACHING SUGGESTIONS:

1. Introduce the lesson by reminding the students that the readings on their rubber band force measurers varied from group to group. Tell them that they are now going to compare two spring scales to see if the readings on them vary.

2. Have the students turn to page 99 and read the first three paragraphs. Teacher may paraphrase.

3. Explain to the students that they are going to compare two spring scales directly in this lesson.

4. Divide the students into groups of 2.

5. Give each group two spring scales.

6. If there are more than 2 students in a group, explain to the students that only two members of each group will be able to test the spring scales at a time. However, they are to take turns so that all group members have a chance to do the tests.

7. Circulate among the students, providing help as it is needed. Students are often surprised to find that the pulls measure the same whether both scales are pulled at the same time or one scale is held in place and the other one is pulled.

8. Encourage the students to think of other ways to test the spring scales.

9. Discuss the numbered questions with the students. If they have difficulty with question 2 ask them why an object on a scale does not keep pulling down until the scale indicator hits the bottom. Also ask them if they think the force of the object pulling down and the force of the spring pulling up are balanced.

DESIRED LEARNING OUTCOME: Ability to compare the readings on 2 spring scales.

****

DEVELOPMENT: 2A-2 Measuring Forces
Page T-172/S-100 Combining Scales (40 min.)

PURPOSE: Measure the weight of large objects using 2 scales and adding the readings.

PREREQUISITES: Ability to add.

ADVANCE PREPARATION:

Background Information - If two scales support an object, the force is shared by the two scales. The readings on the two scales must be added together to find the total force.

Language Cards/Key Signs
combine

Materials: - 2 spring scales for each pair of students
- several heavy objects (see below)

You will need to obtain at least six heavy objects for each of six groups. The objects must be too heavy to weigh on a single spring scale and the students must be able to attach the objects to two spring scales. Try to collect wooden hangers, shoes with laces that may be tied to the scales, notebooks or pads with rings, spiral bindings, or holes punched in them, or empty pocketbooks with handles. You can punch holes in old magazines or tie together stacks of paper or large file cards in which you have punched holes. If you punch holes in objects, be sure that they are on the opposite ends of the same side, not too far from the edge. Two opened paper clips, to be used as hooks, can be attached with masking tape to such objects as small books.

TEACHING SUGGESTIONS:

1. Explain to the students that they are going to use two scales to measure the weight of one object.
2. Divide the class into groups of 2.
3. Have the students turn to page 100 and read as far as the numbered questions. Teacher may paraphrase.
4. Distribute two spring scales and one of the heavy objects to each group as they read.
5. Make certain the students understand that when they weigh an object on two scales, they must add together the forces pulling down on each of the scales. Make sure the scales are held vertically and not at an angle or the scales will be also pulling of each other causing an error.
6. Have the students do the lesson.
7. Suggest that the students find out if the force of an object is the same on two scales placed side-by-side and on two scales attached at opposite ends.
8. Have the students discuss the numbered questions.

DESIRED LEARNING OUTCOME: Ability to measure the weight of at least one heavy object using two scales and adding the two readings.

****

APPLICATION: 2A-2 Measuring Forces
Page T-173/S-101 Everyday Scales (30 min.)

PURPOSE: Enable the students to apply what they have learned about measuring forces with scales to everyday uses of scales.

ADVANCE PREPARATION: None.

TEACHING SUGGESTIONS:

1. Have the students turn to page 101 and do the whole lesson.
2. Let the students discuss the lesson with their neighbors as they work.
3. Discuss all the questions with the students.
4. Ask the students what other types of scales they have seen in stores or at home. They have probably seen scales in grocery stores that are similar to the one pictured at the bottom of the first column on page 101. At home, some students may have seen various food scales including small "diet" scales.

DESIRED LEARNING OUTCOME: Ability to describe at least 3 everyday uses of scales to measure forces.

****

EVALUATION: 2A-2 Measuring Forces
Page T-174/S-102 Weighing In (35-40 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Identifying the force of gravity as the pull on an object on a scale.
2. Recording the weight on an object on a scale.
3. Comparing the weight of an object on a scale with a faulty spring and its true weight.
4. Determining if true weights are more or less than scale readings from pictures that illustrate forces acting in combination.

ADVANCE PREPARATION: Materials - paper
- pencil
- textbook

TEACHING SUGGESTIONS:

1. Have the students turn to page 102 and read through the lesson. Point out that the lesson is continued on page 103.

2. Make certain that they understand what they are to do.

3. Have the students do the lesson.

4. Go over the students' responses with them when they have completed their work.

5. You may wish to let the students correct their own papers so that they can evaluate their progress.

6. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all of most of each question, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

7. For further informal evaluation, have the students turn back to page 82 and look at the picture that introduces Part A. Ask them why they think that particular picture was used to introduce the part. The students should be able to infer that: 1)forces applied to the balls by the hands of the students has pushed some balls into the air. 2)the force of gravity has pulled some balls back into the students' hands. 3) the motion of the balls is not changing and, therefore, the forces are balanced.

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Level 5 Unit 2 Forces

Part B Liquids and Gases, Lesson Cluster 2B-1

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-182	Introduction	Objects in Water	25-30 min.
T-183	Development	Weighing in Water	40-45 min.
T-184	Development	Other Liquids	25-30 min.
T-185	Development	Buoyant Force	25-30 min.
T-186	Development	Floating	40-45 min.
T-188	Development	Making Boats	40-45 min.
T-189	Development	What is Buoyant Force?	30-35 min.
T-190	Development	Weight and Mass	25-30 min.
T-191	Aplication	Measuring Mass	25-30 min.
T-192	Evaluation	Feeding the Fish	30-35 min.

B. MATERIALS: Materials list on T-179.

FILMSTRIP INFORMATION: Filmstrip Set XVI, Pushes and Pulls, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2B-1 Forces in Liquids
Page T-182/S-105 Objects in Water (25-30 min.)

PURPOSE: Introduce the concept of forces acting on objects immersed in water.

ADVANCE PREPARATION: Materials -2.3 buckets (depending on the size of the groups you prefer) or any similar container that will hold about 1 gallon of water
-several large rocks and bricks
-newspaper to put under bucket

Language Cards/Key Signs
weight
objects
liquid

Fill the buckets with water. Place them on several folds of newspaper on the floor away from classroom traffic. Put the rocks and bricks nearby.

TEACHING SUGGESTIONS:

1. Remind the students that in Part A they learned to identify and measure forces on objects in air. Explain that in Part B they are going to investigate how forces act on objects immersed in liquids and in gases. Have the students look at the Part Opener on page 104.

2. Introduce the first cluster by having the students turn to page 105 to read the title.

3. Divide the class into small groups so that each group has a set of materials. Point out the bucket of water and objects to the students. Explain to them that they will go, a small group at a time, to support the objects in and out of the water and other kinds of splashing. Then send the groups to experiment. Ask the children to notice if the objects change in any way as they are lifted out of the water.

4. The teacher should guide the activity so that the children eventually conclude that the objects seem lighter in the water.

5. Once the experiment is complete, have the students do the lesson. Teacher may paraphrase.

6. Discuss all the questions with the students. Have them relate their experience with lifting objects or moving objects under water. Many students will probably relate that they have even lifted a person in water.

DESIRED LEARNING OUTCOME: Ability to relate a firsthand experience in which they found that an object seemed to weigh less in water than it did in air.

* * *

DEVELOPMENT: Lesson Cluster 2B-1 Forces in Liquids
Page T-183/S-106 Weighing in Water (40-45 min.)

PURPOSE: Extend the investigation of the forces acting upon objects in water to the weighing of washers in an out of water.

ADVANCE PREPARATION: Materials -Have the following for each group of 2-3 students
-1 spring scale
-several sheets of newspaper
-6 washers
-paper
-pencil
-ruler
-water supply
-1 8 oz. container for water

Language Cards/Key Signs

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that they are going to find out if washers have the same or different weights in and out of water.

2. Divide the class into groups of 2-3.

3. Distribute the newspapers and have the groups cover their desks.

4. Have the students read page 106 to find out how they are going to weigh the washers. Teacher may paraphrase.

5. Be sure that the students understand what they are to do. Explain that all the students in each group are to copy the chart on page 106 before they test the washers. Also explain that the members of each group are to take turns so that everyone has an opportunity to do the experiment.

6. Distribute the materials or have the groups get their materials from the supply table and begin to work.

7. Have the students discuss question 1 in terms of the data that they recorded on their charts.

8. Have each group return the materials to the supply table. They will need them in the next lesson.

DESIRED LEARNING OUTCOME: Ability to show by measurement that washers weigh less in water than in air.

****

DEVELOPMENT: Lesson Cluster 2B-1 Forces in Liquids
Page T-184/S-107 Other Liquids (25-30 min.)

PURPOSE: Extend what has been learned about the weights of objects in water to the weights of objects in other liquids.

PREREQUISITES: Understanding of decimal relationships.

ADVANCE PREPARATION: None

Language Cards/Key Signs
liquids
evidence

TEACHING SUGGESTIONS:

1. Explain to the students that in this lesson they are going to find out about the weight of objects in liquids other than water.

2. Have the students turn to page 107 and do the lesson. Teacher may paraphrase.

3. Have the students discuss the italicized questions. Be sure that they give reasons for their answers based on evidence in the chart. It should now be clear to them that the weight of an object will appear to be less in any liquid than in air.

4. Ask the students to look at the chart to find out if the weights of three washers differ from liquid to liquid (Yes).

5. Encourage the students to express their own ideas in discussing the numbered questions. They will probably be able to figure out that there is something about liquids that causes objects to weigh less in them than in air. Emphasize such words as "floating" and "being held up" in anticipation of the introduction to buoyant force in the next lesson.

DESIRED LEARNING OUTCOME: Ability to determine that objects have different apparent weights in different liquids.

****

DEVELOPMENT: Lesson Cluster 2B-1 Forces in Liquids
Page T-185/S-108 Buoyant Forces (25-20 min.)

PURPOSE: Extend the investigation of the weight of objects in liquids to the concept of buoyant force.

ADVANCE PREPARATION: None

Language Cards/Key Signs
buoyant force
gravity

TEACHING SUGGESTIONS:

1. Introduce the lesson by writing the term buoyant force on the chalkboard.

2. Have the students read the introductory paragraph on page 108. Be sure the students understand that both liquids and air exert buoyant force on objects, but that the buoyant force of liquids is greater.

3. Review the term gravity, the pulling force of the Earth, pulls down on an object in liquid as well as in air.

4. Have the students do the lesson. Let them discuss their observations with their neighbors as they work.

5. Discuss the first italicized question with the students. If the students have difficulty in interpreting the arrows in the illustration, refer them to the lesson "Showing Forces" on page 89 in which the use of arrows to show the direction and amount of force was introduced.

6. Check the students' understanding of the second italicized question by assigning specific values to the forces. Write "gravity = 2.0 N" and "Buoyant force = 0.2 N" on the chalkboard. Explain to the students that, in the example you have written on the board, the force of gravity acting on an object being weighed in water is 2.0 N. The buoyant force of the water is 0.2 N. Ask them what the reading would be on the scale. (1.8N) Have the students tell you only the process by which the scale reading can be determined from the data if they do not know how to subtract decimals.

7. Have the students discuss the numbered questions. Help the students to understand how the force of gravity and buoyant force are related to the apparent weight of an object in a liquid. (One force is partially offset by the other.)

8. Ask the students why they think the buoyant force of liquids is greater than the buoyant force of air. They will probably say that liquids are "thicker" or "heavier."

DESIRED LEARNING OUTCOME: Ability to explain why objects weigh less in liquids than in air on the basis of the strongest buoyant force of liquids.

****

DEVELOPMENT: Lesson Cluster 2B-1 Forces in Liquid
Page T-186/S-109 Floating (40-45 min.)

PURPOSE: Use what has been learned about buoyant force to explain why objects float.

ADVANCE PREPARATION:

Background Information: A solid object floats if its weight is less than the weight of the water of other liquid that is displaced when the object is totally immersed. The force of gravity pulls down on the object with a force equal to the object's weight. The water or other liquid pushes up on the object with a buoyant force equal to the weight of water or other liquid that

Language Cards/Key Signs
float
liquid
buoyant
aluminum foil

Identification Cards
Objects that Float
Objects that Sink

the object displaces. If the object has a large volume and is relatively light, the buoyant force is sufficient to keep the object afloat. A floating object displaces a volume of water whose weight is exactly equal to the weight of the object.

The aluminum objects that the students make in this lesson will sink or float depending on how much volume of water the objects displace. Using the same size aluminum sheets, the students may wad one into a ball and fashion a watertight box out of the other. The wad will sink because it does not displace enough water to provide buoyant force greater than the weight of the aluminum. The box will float because it displaces a volume of water whose weight equals the weight of the aluminum when the box is partially immersed.

Materials - Have the following for each 2-3 students:
-1 bucket or large container
-newspaper
-2 aluminum foil squares 20 cm x 20 cm (7 in. x 7 in.) for each child

Cover five areas of the floor with newspapers. Fill the buckets with water and put one in each area. Then cut enough aluminum foil squares to provide each student with two of the same size. You may want to cut some extra squares for students who think of more than two objects to make. Use the cardboard to make two signs. Label one "Objects that Float" and the other "Objects that Sink." Clear a large space on a table of counter and put the signs there. After the students test their aluminum objects, they can put each object next to the sign that describes it.

TEACHING SUGGESTIONS:

1. Have the students turn to page 109 and read the introductory paragraph to find out why objects float. Teacher may paraphrase.

2. Be sure the students understand that objects will float in water if the buoyant force or upward push of the water is great enough.

3. Divide the students into groups of 2-3.

4. Ask the students to read through the rest of the lesson to find out what they will be doing. Teacher may paraphrase.

5. Distribute two aluminum foil squares to each student while they are reading.

6. Tell the students that they may begin to make their objects as soon as they have finished reading. Encourage the students to make the objects their own way. Avoid limiting them to any particular design.

7. Assign each group to one of the buckets of water. Let individual members of each group start testing their objects as soon as they have made them. Advise the students to put their objects on the water gently. Caution them against pushing the objects into the water.

8. Point out the area where you have put the signs and ask the students to place each of their objects in front of the sign that describes it.

9. Have the students return to their seats and answer the italicized questions about the picture on page 109 as soon as they have put their objects on the table or counter.

10. Have the groups go to observe the objects that have been grouped in front of the signs. Then have them answer the numbered questions. Remind them to think about the objects that are pictured on page 109 as well as the objects that the class made.

11. Discuss the numbered questions with the students. Encourage them to explain in their own words why objects float or sink. Be sure that the students understand that the objects that they tested were of the same weight. They all were made from pieces of aluminum foil of the same size.

12. Leave the buckets of water where they are or push them to one side, out of the path of classroom traffic. They will be used again in the next lesson. You may want to encourage those students who are interested to experiment during their free time with other aluminum objects or objects made of different materials.

DESIRED LEARNING OUTCOME: Ability to explain why aluminum objects that they make either float or sink in terms of the shape and size of the object.

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DEVELOPMENT: Lesson Cluster 2B-1 Forces in Liquids
Page T-188/S-110 Making Boats (40-45 min.)

PURPOSE: Extend what has been learned about buoyancy to the construction of boats that can carry a load.

ADVANCE PREPARATION: Materials -Have enough of the following for each group of students:
-buckets
-newspaper
-2 aluminum foil squares
-washers
-tape and scissors

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that they are going to use what they learned about floating and sinking in the last lesson to make boats.

2. Divide the class into groups of 2-3.

3. Have the students turn to page 110 and read through the lesson to find out what they are going to do. Teacher may paraphrase.

4. Have each group get its materials.

5. Explain to the students that they should use only small pieces of tape on their boats so that the tape adds very little extra weight.

6. Encourage them to make different kinds of boats.

7. Assign a bucket of water to each group and have the students go by groups to test their boats. Ask them to find out which boat in the group can carry the largest load of washers. Remind the students to "lay" their boats gently on the water.

8. Set up a competition to see which group can design the boat that holds the most weight.

9. Have the students discuss all the questions. Be sure they understand that water rushing through holes that are punched in the sides of boats is evidence that water can push sideways as well as upwards.

10. Ask the students some additional questions: Which boat does the water push up on the most? (The one holding the greatest weight.) What happens when one additional washer causes a boat to sink? (The force of gravity on the boat and its load is greater than the buoyant force of the water.) How does the placement of washers on a boat affect whether the boat floats or sinks? (The placement of washers determines whether or not the forces on the boat are balanced, that is, whether the boat will float in a stable position.)

DESIRED LEARNING OUTCOME: Ability to make a simple boat of aluminum foil that will float while carrying a load of washers.

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DEVELOPMENT: Lesson Cluster 2B-1 Forces in Liquids
Page T-189/S-111 What is Buoyant Force? (30-35 min.)

PURPOSE: Extend what has been learned about floating objects to the relationship of buoyant force to the volume of liquid displaced by a floating object.

PREREQUISITE: Familiarity with the concept of volume and the ability to compute a volume.

ADVANCE PREPARATION:

Background Information: This lesson requires that the students use the mathematical formula for the volume of a solid to compute the volume of water displaced by foil boats shown in pictures. Because most school systems teach this formula at fifth level, the students' familiarity with it is assumed in this lesson.

Language Cards/Key Signs
buoyant force
volume
displaced
displaces

The volume of solids is often measured in cubic centimeters, the volume for which is cm^3. (Students who have done the fouth-level Unit Environments, have learned this measurement and the symbol for it.)

The formula for finding the volume of a solid is: length x width x height = volume. Be certain the students understand that to find a volume in cm^3 they must multiply three cm measurements.

The concept of volume is dealt with in detail in the third cluster of this part (page 123). In this lesson, the students need only know and understand the formula for finding the volume of a solid.

TEACHING SUGGESTIONS:

1. Introduce the lesson by writing displaces and displaced on the chalkboard.

2. Ask the students to turn to page 111 and read the introduction to find out what the term means. Teacher may paraphrase.

3. Discuss the meaning of displaced with the students.

4. Explain to the students that they are going to find out how much water the two boats pictured on page 111 displaced.

5. Review or introduce the term volume and the formula for finding the volume of a solid. (See Background Information.)

6. Distribute the paper and pencils and have the students do the rest of the lesson on page 111.

7. Discuss all the questions with the students. Be sure the students understand that the larger the amount of water displaced by boats or other objects, the greater the buoyant force that pushes up on them.

DESIRED LEARNING OUTCOME: Ability to find the volume of water displaced by 2 pictured boats and determine that a greater buoyant force is exerted on one of the boats.

****

DEVELOPMENT: Lesson Cluster 2B-1 Forces in Liquids
Page T-190/S-112 Weight and Mass (25-30 min.)

PURPOSE: Relate what has been learned about the weight of objects in liquids and in air to the mass of objects in liquid and in air.

ADVANCE PREPARATION:

Background Information: In this lesson, a simple definition of mass is presented. The definition is designed to distinguish mass from weight. Mass, essentially, is how much matter there is in an object. In direct contrast to weight, the mass of an object is constant. The mass of an object does not change, unless the amount of matter in the object changes.

Language Cards/Key Signs
weight
mass
matter
buoyant force

TEACHING SUGGESTIONS:

1. Write the term mass on the chalkboard. Explain to the students that they will learn about the term in the lesson they are going to do.

2. Have the students read the introduction on page 112 to find out what the mass of an object is and how the mass of an object differs from the weight of an object. Teacher may paraphrase.

3. Make certain that the students understand that mass is the amount of matter in an object, and that mass changes only when the amount of matter changes.

4. Remind the students that they found in their experiments that washers weighed less in a liquid than they did in air. Ask them if the mass of the washers changes in a liquid. (no.)

5. Have the students do the rest of the lesson.

6. Discuss all the questions with the students. Emphasize that the weight of an object can change, even though its mass stays the same.

DESIRED LEARNING OUTCOME: Ability to describe mass as the amount of matter in an object, and state that the mass of an object does not change even though its weight may change.

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APPLICATION: Lesson Cluster 2B-1 Forces in Liquids
Page T-191/S-113 Measuring Mass (25-30 min.)

PURPOSE: Measure the mass of an object in kilograms and grams.

ADVANCE PREPARATION: Materials -adjustable balance with standard masses or "weights"
-objects to find mass of

If you plan to provide the students with firsthand experience in using a balance with standard masses, or "weights," obtain a balance and set it up in a central location. Let the students find the masses of various small objects in the classroom during their free time. Label the balance with identification card.

Language Cards/Key Signs
mass
kilograms
grams
balance

Identification Cards
balance (if balance is left on display in classroom)

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that you can measure the mass of an object.

2. Have the students read the introduction on page 113.

3. Be sure the students understand the symbols kg and g.

4. Have the students read the last paragraph in the first column and study the pictures on page 113.

5. Ask students the following questions to make sure that they understand how a balance is used: What are the instruments in the pictures called? (Balances.) For what are they used? (To measure the mass of objects.) Which object did the woman first put on the balance? (The container of blue liquid.) What is the woman doing in picture A? (Adding objects of known mass to the other pan to balance the mass of the container of blue liquid.) How can you tell a balance is "balanced"? (When both sides of the balance are on the same level.) How will the woman find out what the mass of the container of blue liquid is? (She will add up the masses of the objects that balanced the container of blue liquid.)

6. Explain to the students that the force of gravity acting on each pan of a balance is the same. Each pan is pulled by the Earth with the same amount of force. Masses on the pans of a balance can, therefore, be compared.

7. Have the students do the remainder of the lesson.

8. Discuss the use of kilograms to measure the mass of large objects and the use of grams to measure the mass of small objects. Then discuss the numbered questions.

9. Point out to the students where you have put the balance if you have obtained one for their use. Tell them that the objects of known mass that they will use to balance classroom objects have their masses marked on them.

DESIRED LEARNING OUTCOME: Ability to describe how the mass of an object can be found using a balance.

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EVALUATION: Lesson Cluster 2B-1 Forces in Liquids
Page T-192/S-114 Feeding the Fish (30-35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Describing why a box floats.
2. Determining whether the force of gravity or the buoyant force is greater on an object in water.
3. Comparing the apparent weight of an object in water and in air.
4. Comparing the mass of an object in water and in air.

ADVANCE PREPARATION: Materials -paper and pencils
-textbook

TEACHING SUGGESTIONS:

1. Have the students turn to page 114 and read through the lesson. Teacher may paraphrase text and questions.

2. Have the students proceed with the lesson when you are sure that they understand what they are to do.

3. Go over the students' responses with them when they have completed their work. You may wish to let them correct their own papers so that they may evaluate their own progress.

4. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 5 Unit 2 Forces

Part B Liquids and Gases, Lesson Cluster 2B-2

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-198	Introduction	The Air Around Us	25 min.
T-199	Development	Air Can Cause Pushes	40 min.
T-200	Development	Measuring PUshes	40 min.
T-201	Development	Making a Rocket	45 min.
T-203	Development	Adding a Return Rocket	40 min.
T-204	Development	Carrying a Load	35 min.
T-205	Application	Rocket Action	30 min.
T-206	Evaluation	Balloon Watching	30 min.

B. MATERIALS : Materials list on page T-195.

FILMSTRIP INFORMATION: Filmstrip Set XVI, Pushes and Pulls, is appropriate for use in this unit.

INTRODUCTION: 2B-2 Forces in Gases
Page T-198/S-115 The Air Around Us (25 min.)

PURPOSE: Review the concept thatair is a mixture of gases and to introduce the concept that gases can cause forces.

ADVANCE PREPARATION: Materials - Any media about windmills, such as pictures, filmstrips.
- If possible, a model of a windmill or a pinwheel to demonstrate the force of air.

If you plan to have some or all the students look up information about windmills, obtain some books from the school or public library for them to use.
If you assign this project to all students, avoid having the entire class go to the library for only a few books will probably be available at the elementary level.

Language Cards/Key Signs
air
gases
windmill
force
liquid

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the cluster by having the students turn to page 115 to read the title of the cluster. Explain that gases can cause forces just as liquids can.

2. If a pinwheel or model windmill is available, demonstrate how air forces movement of the blades.

3. Show the class any pictures, etc. of windmills that are available.

4. Have the students read page 115. Teacher may paraphrase.

5. Discuss the lesson with the students. If they have done the fourth-level Unit, Exploring Matter, they will probably remember that air is a mixture of gases. You may want to review from that Unit or introduce such prop erties of gases as "lack of definite shape," "move freely," and "fill all the space in a container."

6. Ask the students what objects they have observed that have been knocked over by the force of wind. Their answers will depend on experiences that they may have had with hurricanes or tornadoes or on pictures that they may have seen of severe wind damage.

7. Extend the lesson, if you wish, by asking some or all students to do research on windmills to find out some of the ways in which wind power can be used. Point out to them where you have placed the reference materials that you have gathered. Tell the students whether the reports are to be or al or written and decide with them the time limit for doing the reports. Provide time during a future class for the students to share their reports.

8. Discuss the numbered questions with the students.

DESIRED LEARNING OUTCOME: Ability to give at least 2 examples of forces caused by moving air.

****

DEVELOPMENT: 2B-2 Forces in Gases
Page T-199/S-116 Air Can Cause Pushes (40 min.)

PURPOSE: Extend what has been learned about forces caused by moving air to forces caused by air that is not moving.

Language Cards/Key Signs

Identification Cards

ADVANCE PREPARATION: Materials - Have the following for each group of 2-3 students:
- 1 bucket, 3.8L (1 gal.) or large bowl or basin
- newspaper
- 1 plastic drinking glass
- 1 plastic drinking glass, larger than the first (optional)

Fill buckets with water and place them on a suppply table with the drinking glasses and folds of newspapers. Large bowls or basins may be used if buckets are unavailable.

TEACHING SUGGESTIONS:

1. Ask the students to turn to page 116 and read the introduction to the lesson. Teacher may paraphrase.
2. Explain to the students that in the previous lesson they learned about forces caused by moving air. In this lesson, they are going to do an experiment to find out if air can cause a force when it is not moving.
3. Divide the class into groups of 2-3.
4. Have the students read the rest of column 1 and look at the picture to find out how to do the experiment.
5. Distribute the newspaper while they are reading.
6. Have the students cover their desks with newspaper.
7. Distribute a bucket of water and a glass to each group.
8. Explain to the students that they are to take turns working with the bucket of water and glass so that everyone has an opportunity to do the experiment.
9. Have the students do the experiment and answer the questions.
10. Discuss the italicized questions with the students. Be sure they understand that the submerged cup is not empty. It is filled with air. Have them find other objects in the classroom that are filled with air.

DESIRED LEARNING OUTCOME: Ability to describe the upward push (buoyancy) caused by stationary air trapped in a submerged container.

****

DEVELOPMENT: 2B-2 Forces in Gases
Page T-200/S-177 Measuring Pushes (40 min.)

PURPOSE: Measure a force caused by air that does not move.

Language Cards/Key Signs
push
trapped air

Identification Cards

ADVANCE PREPARATION: Materials - Have the following for each group of 2-3 students:
- 1 bucket or large bowl or basin
- newspaper
- 10 metal washers
- 1 set of 3, different sized plastic or paper cups; they must be small enough to submerge in the buckets or bowls
- 2-3 sheets of paper
- 2-3 rulers
- 2-3 pencils

TEACHING SUGGESTIONS:

1. Have the students turn to page 117 and read through the lesson and look at the picture to find out how they are going to measure the force caused by trapped air. Teacher may paraphrase.

2. Divide the students into groups of 2-3.

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3. Distribute the paper and pencils and have each student copy the chart on page 117.

4. Have each group get two folds of newspaper, a set of three containers, and ten washers from the supply table.

5. Give a bucket of water to each group.

6. Remind the students to test each container twice.

7. Have the students do the experiment, record the results, and then answer the questions.

8. Have the students discuss the questions.

9. Draw three containers on the chalkboard that are similar to a set used by the students.

10. Ask the students which container holds the largest, the next-largest, and smallest volume of air. Write the numbers on the containers from largest (1) to smallest (3). Then ask the students which container needed the largest number of washers to hold it down, which the next largest number and which the smallest. Write these numbers under each container from most washers (1) to least (3). Help the students to understand that as the volume of air decreased, the push (buoyancy) of air also decreased and fewer washers were needed.

11. Ask the students how many washers would be needed to hold down a container twice as large as the largest container they used. (Twice as many.)

DESIRED LEARNING OUTCOME: Ability to measure the upward forces caused by air trapped in submerged containers and relate differences in the forces to differences in the volume of trapped air.

****

DEVELOPMENT: 2B-2 Forces in Gases
Page T-201/S-118 Making a Rocket (45 min.)

PURPOSE: Extend what has been learned about the force caused by moving air to the use of that force to propel a balloon rocket.

ADVANCE PREPARATION:

Background Information - When a gas is under pressure, the force it exerts inside its container is exerted equally in all directions. When the air in a balloon is allowed to escape, force is still being exerted on the front and sides but not on the rear where the gas is escaping. Thus, the balloon moves forward in response to the unbalanced force in that direction.

Materials - Have the following for each pair of students:
- 1 balloon*
- 1 drinking straw
- twist-tie or paper clips, jumbo
- scissors

*All balloons must be same size; have extra in case some break.

Language Cards/Key Signs
rocket
rocket system
variable

Identification Cards

Also have on hand: - masking tape
- string, several yards

Collect the balloons, straws, rolls of tape, and scissors and put them on a supply table. Fifteen balloons will be needed in this lesson. Have the five extra balloons available in case some break. If you collect double the number of balloons, you will have enough for the next lesson, too.

Cut 15 pieces of string that are 5m (5½ yds.) long and put them with the other materials. Collect either the twist-ties or paper clips. You will find that twist-ties work better and are easier for the students to use to close the ends of the balloons than paper clips. Paper clips tend to cause the opening of the balloon to stick together and weaken during the activity. Also, the balloon is more likely to be punctured by a paper clip than by a twist-tie. If you collect double the number of twist-ties, you will have enough for the next lesson, too.

Clear an area in the room where the students can test their rockets.

TEACHING SUGGESTIONS:

1. Have the students turn to page 118 and read through the lesson to find out how they are going to use the force that moving air causes. Teacher may paraphrase.

2. Divide the students into pairs, and explain that each pair will make a rocket system.

3. Send several pairs of students to the supply table to get their materials. Explain that they should cut off a piece of tape about 5 cm (2 in.) long and stick the end of it to their desk until they are ready to use it.

4. Have the students make their rockets, but caution them to wait until everyone has finished before testing them.

5. Caution the students against carelessly playing with the balloons. Remind them that someone can get hurt.

6. Point out the area that you have cleared for the students to test their rockets. Make a chalkmark on the floor where the students are to stand when they release their rockets.

7. Have one pair of students at a time test their rockets while the rest of the class observes. The students will probably find that a rocket works best when one student holds the balloon closed just above the twist-tie while the other undoes the twist-tie. The first student than releases the balloon.

8. Have each pair of students place an object such as a book to mark how far their rocket traveled. The students will then be able to determine later whose rocket went farthest.

9. Have the students discuss the italicized questions. Be sure they understand that the pushing force caused by escaping air makes their rockets "fly."

10. Discuss the numbered questions with the students.

11. You may want to review or introduce the term variable at this time. Students who have done the fourth-level Unit Exploring Energy will probably remember that a variable is something in a system that can or is likely to change. At fourth level, the students learned about variables in sound and heat systems and in

electric circuits. The term is reviewed in the first cluster of Part C of this unit, on page 132.

12. Ask the students what variables there are in their rocket systems. The variables they isolate will probably include: the tautness of the string; the angle of the string; the size of the inflated balloon; the width of the balloon stem; the length of the straw.

13. Have the students analyze the most successful long-distance rocket systems to determine if the students who made them controlled the same variables. Have them analyze the most reliable systems also. Have the students test the variables they can identify to find out if they can, by controlling the variables, make a rocket go the maximum distance possible and make it go the same distance on every try.

14. Have the students store their rocket systems in a safe place. They will use them again in the next lesson. The scissors and tape also will be used again in the next lesson.

DESIRED LEARNING OUTCOME: Ability to make a balloon rocket and describe how the force caused by escaping air makes the rocket move.

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DEVELOPMENT: 2B-2 Forces in Gases
Page T-203/S-119 Adding A Return Rocket (40 min.)

PURPOSE: Use the force of escaping air to make a balloon rocket travel back to its starting point.

ADVANCE PREPARATION: Materials - Have the following for each pair of students:
- 1 balloon
- twist-tie or paper clips, jumbo
- scissors

Also have on hand:
- masking tape
- rockets from Making A Rocket on page 118
- extra balloons in case some break

Language Cards/Key Signs
balloon rocket
return rocket

Identification Cards

TEACHING SUGGESTIONS:

1. Divide the students into the same pairs as before.

2. Have the students turn to page 119, read through the lesson, and look at the pictures. Teacher may paraphrase.

3. Be sure the students observe where the straw and string and pieces of tape are placed as well as the direction of the tied-end of each balloon.

4. Have the pairs of students get their rockets, a new balloon, a twist-tie, scissors, and a piece of tape from the supply table and begin to work.

5. Caution the students against carelessly playing with the balloons. Remind them that someone can get hurt.

6. Have the students go a few at a time to test their rockets. Be sure they know they are to first observe what happens when they release the air in one balloon at a time. Then they are to observe what happens when they release the air in both balloons at the same time.

7. Explain that it will be difficult to release their rockets at the same time if they have to undo the twist-ties. It will be easier if they hold the balloons by the stems and release them on signal. They should leave the twist-ties on only while making the system.

8. Discuss the italicized question. Ask if the results would be the same if the rockets were positioned "nose to nose" (end without opening to end without opening). (No, the balloons would not move.)

9. Discuss the numbered questions with the students.

10. Have each pair of students carefully separate the two balloons in their rocket systems. Using the balloon that is in better condition, have them reconstruct the original balloon rocket with a string. Store the rockets for use in the next lesson.

DESIRED LEARNING OUTCOME: Ability to describe how they used the force of escaping air to make a rocket move back and forth or remain stationary.

****

DEVELOPMENT: 2B-2 Forces In Gases
Page T-204/S-120 Carrying A Load (35 min.)

PURPOSE: Find out how the addition of a load to a balloon rocket affects the motion of the rocket.

ADVANCE PREPARATION: Materials
- 1 metal washer for each pair of students
- masking tape
- rockets from Making A Rocket, page 118
- a collection of small objects such as paper clips, markers, erasers, coins, pencils or ballpoint pens

Language Cards/Key Signs
load

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that they changed their original rocket systems by adding a second rocket. They will now change it by adding a load.

2. Divide the students into the same pairs that have been working together.

3. Have the students turn to page 120, read the lesson, and study the pictures. Teacher may paraphrase.

4. Have the students get their rockets and one washer.

5. Have the students do the lesson through the first italicized question. Most students will probably tape the washers flush onto the balloons. Some may think of suspending the washers from the balloons.

6. Send a few pairs of students at a time to test the rockets.

7. Discuss the italicized questions with the students. Their answers are likely to vary.

8. Have each pair of students choose an object from the supply table and do the second part of the lesson as far as the numbered questions.

9. Have students take turns assembling a collection of objects equal in total weight to one large washer. Have them use two spring scales to balance the objects and the washer. Have some pairs use bulky objects such as folded paper shapes or streamers and then compare their results with pairs that used marbles, erasers, or other compact objects.

10. Discuss the last italicized question and the numbered questions with the students. Be certain to discuss all the variables that affected how well their rockets carried loads. Weight is clearly a variable, but some students will also be able to conclude that bulky loads do not travel as far because of greater resistance.

DESIRED LEARNING OUTCOME: Ability to describe how the weight, shape, and bulkiness of the load and the way in which the load was attached affected the motion of their rockets.

****

APPLICATION: 2B-2 Forces in Gases
Page T-205/S-121 Rocket Action (30 min.)

PURPOSE: Apply what has been learned about the forces produced by escaping air to the motion of rockets in outer space.

ADVANCE PREPARATION: Materials - none.

TEACHING SUGGESTIONS:

Language Cards/Key Signs
balanced force
unbalanced force

Identification Cards

1. Have the students look at the picture of the balloon with arrows. Review the use of arrows to show the direction and amount of forces.

2. Review the concepts of balanced and unbalanced forces, making sure the students understand that balanced forces cause neither motion nor change of motion and unbalanced forces may cause either. Ask the students whether balanced or unbalanced forces caused their balloon rockets to move. (Unbalanced.)

3. Have the students turn to page 121 and do the lesson. Teacher may paraphrase.

4. Discuss the italicized questions that deal with the balloon rockets in air.

5. Draw a diagram on the chalkboard similar to the one on page 121, omitting the arrows and paper clip in the top balloon.

6. Ask a student to go to the board and draw arrows inside the balloon to show the unbalanced forces in the balloon. Be sure that shorter arrows are used to show air escaping from behind the balloon (open end) and that longer arrows are used to show air pushing primarily on the "nose" of the balloon (other end).

7. Have the students discuss the rest of the italicized questions and the numbered questions.

DESIRED LEARNING OUTCOME: Ability to compare the cause of motion in their balloon rockets and rockets in space on the basis of the unbalanced forces of air inside both rockets.

* * *

EVALUATION: 2B-2 Forces in Gases
Page T-206/S-122 Balloon Watching (30 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Identifying which of 2 balloons of different volumes would be easier to hold under water.
2. Identifying which of 2 balloons of different volumes would travel faster.
3. Identifying which of 2 balloons would travel farther on the basis of the of the weight of their loads.
4. Identifying which of 2 balloons would rise higher on the basis of their shapes and the weight of their loads.

ADVANCE PREPARATION: Materials - paper, pencil, textbook

TEACHING SUGGESTIONS:

1. Have the students turn to page 122 and read through the lesson. Teacher may paraphrase text and questions.

2. Have the students proceed with the lesson when you are certain that they understand what they are to do.

3. Go over the responses with the students when they have completed their work.

4. You may wish to let them correct their own papers so that they may evaluate their own progress.

5. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

* * *

Level 5 Unit 2 Forces

Part B Liquids and Gases, Lesson Cluster 2B-3

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-212	Introduction	What Is Volume	30-35 min.
T-213	Development	Liquid Volumes	35 min.
T-214	Development	Finding Volumes	45 min.
T-216	Development	Volumes of Solids*	30min./50 min.
T-218	Development	Weighing Water	40 min.
T-219	Application	Volume and Weight	20 min.
T-220	Evaluation*		

NOTE: *Lesson Volumes of Solids may be done over a 2 day period. Wrap Up has been omitted from this cluster.

B. MATERIALS: Add the following to the Materials List on page T-209 -
- 1 set of 30 cubes, 1 cm x 1 cm x 1 cm each
- copy of chart on page 129; can either be on a transparency or board

FILMSTRIP INFORMATION: Filmstrip Set XVI, Pushes and Pulls is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2B-3 Volume
Page T-212/S-123 What Is Volume? (30-35 min.)

PURPOSE: Review or introduce the concept of volume as a measure of space occupied.

ADVANCE PREPARATION:

Background Information - Volume is the measure of the amount of space that a solid, a liquid, or a gas occupies. In the metric system, volume is measured in liters (L) or in milliliters (mL) and cubic centimeters (cm^3). For all practical purposes, a mL is equal to a cm^3. See Background Information in What Is Buoyant Force? on page T-189.

Materials - 30 cubes 1 cm x 1 cm x 1cm;
see picture on page 123.

Language Cards/Key Signs
volume
cubic centimeters
cube

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the cluster by telling the students that they are going to learn more about volume. Ask the students what the term means and how they used volume in previous lessons. The students should remember that they used the formula for volume to find the volume of water displaced by a floating object. Have them turn back to page 111 to What Is Buoyant Force? if they cannot remember.

2. Ask the students what units of measurement they used to figure out buoyant force. Write cm^3 on the board under volume as a reminder.

3. Use the set of 30 cubes to demonstrate volume as it was done on page 123.

4. Have the students turn to page 123 and do the lesson. Remind them to study the pictures carefullly.

5. Discuss the questions with the students.

6. Be certain the students understand that 1 cm^3 equals 1 mL. They are probably familiar with the former unit. Also be sure they understand that L is a much larger measure of volume: 1000 cm or 1000 mL = 1 L.

DESIRED LEARNING OUTCOME: Ability to describe volume as the amount of space that an object occupies.

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DEVELOPMENT: Lesson Cluster 2B-3 Volume
Page T-213/S-124 Liquid Volumes (35 min.)

PURPOSE: Extend the concept of volume to accurate measurement of the volume of water in containers.

ADVANCE PREPARATION:

Background Information - It is difficult to get an absolutely flat level of water in a glass container. Looked at closely, the surface is curved. This curve is called the meniscus. The correct way to read the level of water in a glass container is at the bottom of the curve. In a plastic container, there is little or no meniscus.

Language Cards/Key Signs
liquid volume
level

Identification Cards

Materials - Have the following for each group of 2-3 student:
- 2 metric measuring containers, 30 mL and 130 mL*
- newspaper
- 2-3 rulers
- 2-3 pencils
- 2-3 sheets of paper

*If you are unable to obtain containers of the specified sizes, others may be used as long as the containers are calibrated and of two different sizes.

TEACHING SUGGESTIONS:

1. Have the students turn to page 124 and read the first column to find out how volumes of liquids are accurately measured. Teacher may paraphrase.

2. Distribute the paper and pencils and have each student copy the chart in the second column.

3. Divide the students into new groups of 2-3.

4. Have the students read the second column to find out what they are going to do.

5. Have the students cover their desks with newspapers.

6. Have the students practice measuring the volumes of liquids in the containers before they try to find the volume of the space above the marking on each container.

7. Let the students devise their own methods for measuring the volume above the markings on the containers. They may add measured amounts of water from one container to the top, or pour the liquid above the top mark into the other container.

8. Have the students discuss the numbered questions.

9. Ask the students to return the calibrated containers to the supply table. The containers should be emptied and left on the supply table ready for use in the next lesson.

DESIRED LEARNING OUTCOME: Ability to measure the volume of water in metric measuring containers.

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DEVELOPMENT: Lesson Cluster 2B-3 Volume
Page T-214/S-125 Finding Volumes (45 min.)

PURPOSE: Measure the volume of uncalibrated containers in this lesson.

ADVANCE PREPARATION: Materials
- For each group of 2-3 students have the following:
- 2 metric measuring containers, 30 mL and 130 mL
- containers assorted in size*
- 2-3 pencils
- 2-3 sheets of paper
- newspaper

Language Cards/Key Signs
unmarked containers
estimated
measured

Identification Cards

*The students will need a variety of uncalibrated containers in this lesson. Try to collect five of each different container such as paper cups of different sizes, filmstrip cans, vials or pill bottles, shallow dishes, and straws. Just be sure that the total collection has a variety of shapes and sizes. Each group of 2-3 students should have a set of 2-3 containers.

TEACHING SUGGESTIONS:

1. Have the students read the lesson on page 125. Teacher may paraphrase.

2. Divide the class into groups of 2-3.

3. Distribute one measuring container and a set of uncalibrated containers to each group, as well as paper, pencils, and rulers.

4. Have the students copy the chart on page 125. Have them write in the names of the containers in their sets.

5. Have someone from each group get newspapers from the supply table and cover the group's working area. Have another student from each group get the group's supply of water.

6. Have the students do the lesson. If necessary, the teacher may work along with the students and demonstrate what is to be done. Remind them first to estimate the volume of a container and then measure it.

7. Let the students experiment with different methods of measuring volumes of the containers. Methods will probably include filling the containers with water from a calibrated container. Students occasionally submerge containers upside-down in a calibrated container partially filled with water and measure the change in the water level.

8. Discuss the numbered questions with the students. Have them compare volumes for common containers using their charts. Also have them discuss how close their estimated volumes were to their measurements.

DESIRED LEARNING OUTCOME: Ability to measure the volumes of several uncalibrated containers.

****

DEVELOPMENT: Lesson Cluster 2B-3 Volume
Page T-216/S-126 Volume of Solids (30 min./50 min.)

PURPOSE: Extend what has been learned about measuring volumes of liquids to the measurement of volumes of solids.

PREREQUISITES: Ability to muliply 3 numbers together, as in 2 × 6 × 4 = ?
Ability to subtract 2 and 3 digit numbers.
Ability to estimate volumes.

ADVANCE PREPARATION: Materials - For each group of 2-3 students have each of the following:
- 1 set of 2 measuring containers, 30 mL and 130mL
- newspaper
- 2-3 rulers
- 1 set of assorted objects*
- 2-3 small lumps of modeling clay
- 2-3 scissors
- 2-3 pieces of paper and pencils
- also have masking tape on hand

Language Cards/Key Signs
solids
volume
displaces
length
width
height
regular solid

Identification Cards

*The students will need a variety of objects. Try to collect four each of such objects as hard-boiled eggs, plastic and hollow table-tennis balls, marbles, and small rocks. Try to provide the students with objects of various shapes and sizes, some of which will float. Each of the 2-3 groups of students should have four objects.

Put the set of objects, paper, pencils, rulers, newspapers, tape, scissors, washers, and measuring containers on the supply table.

Divide the modeling clay into 30 lumps. The lumps should not be any particular shape. The students form shapes with the clay in the lesson.

TEACHING SUGGESTIONS:

1. Have the students turn to page 126 and read the introductory paragraph. Teacher may paraphrase.

2. Explain to the students that they will first use pictures to find volumes of solids in both ways discussed.

3. Have the students read the rest of page 126 and answer all the questions. Teacher may paraphrase. Explain that a regular solid has straight or flat sides and so it can be measured with a ruler.

4. Discuss the first italicized question with the students. Write the formula length x width x height = volume on the chalkboard. Ask the students if they could use the formula for finding the volume of the rock in picture B. (The formula will not work for irregularly shaped objects.)

5. Have the students give their responses to the second italicized question. Be sure they understand that, to find the volume of an object by water in the container without the object in it from the volume of the water with the object in it.

6. Discuss the italicized question about finding the volume of an object that floats. The students will probably remember that, in What is Buoyant Force? on page 111, they used the formula for volume. However, remind them that they used the formula to find the volume of the water that was displaced by floating boats, not to find the volume of the boats. They could use the formula because the length and width of the boats and how far they sank into the water could be measured.

7. Let the students give their opinions about finding the volume of a floating object. Tell them that they will have an opportunity to experiment with volumes of floating objects. If there isn't time now for experimentation, end today's lesson here.

8. Have the students read page 127.

9. Divide the students into groups of 2-3.

10. Distribute 2-3 lumps of clay, 2-3 washers, a set of four other objects, paper, pencils, and rulers to each group.

11. Have the students copy the chart on page 127 and write in the names of the objects you have given them.

12. Have someone from each group get newspapers from the supply table to cover the working area. Have others get a measuring container and the supply of water.

13. Have the students begin. Remind them first to estimate the volume of a container and then to measure it.

14. Let the students experiment with different methods of finding the volume of an object that floats. Help those who have difficulty with such questions as: What is the problem that you are having with the object? (It floats.) What do you want it to do? (Sink.) Could you use any of the other objects to solve the problem? (Yes, add clay to make it sink.) Be sure the students understand that they must subtract the volume of the clay from the volume of the object and clay to find the volume of the object.

15. Have the student use a small piece of tape to hold the clay on the object if the clay will not stick to it by itself.

16. Let the students experiment to find ways to find the volume of small objects that do not displace enough water to measure. Some will probably figure out that they must measure the volume of several of the objects and then divide by the number of objects to get the volume of one.

17. Discuss the numbered questions with the students. Have them compare volumes for common objects using their charts. Also have them discuss the accuracy of their estimations. Be sure the students understand, in discussing question 3 that changing the shape of a clay object will change neither its volume nor its mass.

DESIRED LEARNING OUTCOME: Ability to compute the volume of a regular solid and measure the volume of an irregular solid by water displacement.

****

DEVELOPMENT: Lesson Cluster 2B-3 Volume
Page T-218/S-128 Weighing Water (40 min.)

PURPOSE: Extend what has been learned about measuring volume to the comparison of different volumes and weights of water.

ADVANCE PREPARATION: Materials - For each group of 2-3 students have the following:
- 2-3 pieces of paper
- 2-3 pencils
- 1 set of measuring containers, 30mL and 130 mL
- 2-3 rulers
- newspaper
- 1 spring scale

- 1 paper cup, 8 oz.
- 2 jumbo paper clips

Language Cards/Key Signs
weighing
weight
volume
water
newtons

Identification Cards

TEACHING SUGGESTIONS:

1. Write the term weight on the chalkboard and ask the students what the meaning of the term is. They will probably remember weight as the force of gravity on an object.

2. Have the students read column one on page 128. Teacher may paraphrase.

3. Divide the class into groups of 2-3.

4. Have the groups get their materials at the supply table.

5. Let each group make their weighing bucket, following the directions on page 128. Teacher may demonstrate if necessary.

6. Students should read the first paragraph in column 2 and adjust the spring scale to zero. They may need assistance at this point.

7. Students should now read the next paragraph and complete the activity.

8. Have the students return all the materials to the supply table as they complete the measurements.

9. Have the members of each group compare their charts and discuss the questions.

10. Ask the students to look at their charts to see if they can find a relationship between the volume and weight of water. If the students do not discover the relationship between the volume and weight of water, write the following on the chalkboard to help them:

    100 mL water weighs about 1 N.
    50 mL water weighs about 0.5N

    Further their understanding by also copying the data from their charts on the board. Let the students analyze the relationship of the volumes and weights of water.

DESIRED LEARNING OUTCOME: Ability to measure the volume and weight of different amounts of water and describe the relationship between the volumes and weights.

****

APPLICATION: Lesson Cluster 2B-3 Volume
Page T-219/S-129 Volume and Weight (20 min.)

PURPOSE: Apply what has been learned about the proportional relationship of the volume and weight of water to the proportional relationship of volumes and weights of other liquids.

ADVANCE PREPARATION: Materials - Make a copy of the chart on page 129 on a transparency or the board.

Language Cards/Key Signs
volume
weight
double
equal

Identification Cards

TEACHING SUGGESTIONS:

1. Review the concept that equal amounts of water weigh the same, but different volumes of water have different weight. Also review the proportional relationship of the volumes and weights of water.

2. Explain that in this lesson they are going to find out if the volumes and weights of other liquids have the same relationship.

3. Have the students read column one on page 129. Teacher may paraphrase.

4. Discuss the questions as a group, referring to the chart on the transparency or board.

5. Have students who are interested measure and compare the volumes and weights of different liquids on their own. Tell them that their results may vary depending on the brands of liquids that they use. Let the students borrow the necessary equipment to do the tests at home or have them bring in various liquids to do the tests as a free-time activity.

DESIRED LEARNING OUTCOME: Ability to state from data on a chart that when the volumes of different liquids are doubled, their weights are also doubled.

****

Level 5 Unit 2 Forces

Part C Simple Machines, Lesson Cluster 2C-1

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-226	Introduction	Making Things Move	40 min.
T-228	Development	What Makes Things Move?	40 min.
T-229	Development	Friction	35 min.
T-230	Development	Changing Direction	50 min.
T-232	Development	The Inclined Plane	20 min.
T-233	Application	Inclined Planes	25 min.
T-234	Application	Wedges	30 min.
T-235	Evaluation	Comparing Forces	30 min.

B. MATERIALS: Add the following to the Materials List on page T-223:
-2 blocks of wood, any size will do
-magnifying glass

FILMSTRIP INFORMATION: Filmstrip Set XVI, Pushes and Pulls, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2C-1 Putting Forces to Work
Page T-226/S-132 Making Things Move (40 min.)

PURPOSE: Introduce the concept that changes in variables can alter motion in systems.

ADVANCE PREPARATION: Materials -For each group of 2-3 students have the following:
-1 spring scale
-2 or 3 jumbo paper clips
-1 set of objects from the classroom*
-2-3 sheets of paper and pencils
-1 scissors

Language Cards/Key Signs
variable
system
move
change
movement

*Each group should have 2 or 3 objects so that each student has an opportunity to test one. Either collect sets of such objects as books, notebooks, staplers, paper punches, large tape dispensers and small rocks or let the students in each group experiment with objects of their own choosing. The sets of objects do not have to be the same.

TEACHING SUGGESTIONS:

1. Introduce the cluster by telling the students that they are going to use forces to move objects.

2. Have the students turn to page 132 and read the introduction to find out how movement in a system can change. Teacher may paraphrase.

3. Be sure the students understand that a variable is any property of a system that can be changed. If a variable changes, the system changes.

4. Have the students read the rest of page 132 and answer the questions about the picture. Teacher may paraphrase.

5. Discuss the questions with the students. Help them understand that changes in such variables in the bicycle system as the loaded basket or the surface or incline of the road would change the amount of force needed to move the bicycle system.

6. Introduce the second part of the lesson by telling the students that they are going to measure forces needed to keep objects moving.

7. Have the students read through the directions on page 133 and make sure that they understand what they are going to do.

8. Divide the class into groups of 2 or 3.

9. Have the groups go to the supply table one at a time to get a spring scale, 2-3 paper clips, a strip of tape, two sheets of paper and two pencils. Have them either get a set of objects that you collected or let them choose their own.

10. Remind the students to copy the chart before beginning the experiments. Make sure that they have a level surface on which to put the objects that they test. Also make sure the students understand that the reading they want is of the force required to keep the object moving at a constant speed.

11. It may be helpful to demonstrate the activity to the students before they begin.

12. Discuss the questions with the students. Have them compare the results of tests for common objects using the information on their charts, The students should not be expected to list every variable.

13. Commend any students who observe that the force needed to start an object moving is greater that the force needed to keep it moving. Tell them that they will experiment further with this idea in the next lesson.

14. Have the students look at their charts to find which objects required a force of 1-2.5N to pull them. Collect one of these objects from each group and put them in a special place for use in the next lesson.

DESIRED LEARNING OUTCOME: Ability to name some variables in a moving system and measure the force necessary to move objects.

****

DEVELOPMENT: Lesson Cluster 2C-1 Putting Forces To Work
Page T-228/S-134 What Makes Things Move? (40 min.)

PURPOSE: Extend the investigation of the variables that affect motion to the concept that it requires more force to set an object in motion than to keep it in motion.

Language Cards/Key Signs
variable
force
smoothness

ADVANCE PREPARATION: Materials -Each group of 2 or 3 students will need the following:
-1 spring scale
-1 jumbo paper clip
-scissors
-2 pieces of waxed paper
-2-3 pieces of paper and pencils
-1 object from Making Things Move
(See Teaching Suggestion 14 from that lesson)
-a piece of masking tape

TEACHING SUGGESTIONS:

1. Tell the students that they are going to learn more about how variables affect moving objects.

2. Divide the class into groups of 2 or 3.

3. Have the students turn to page 134 and read to the end of the italicized questions, answering the questions when they come to them. Teacher may paraphrase.

4. Let the students express their own opinions in discussing the questions. Explain to them that they will have an opportunity to test their ideas in the second part of the lesson.

5. Have each group go to the supply table to get materials: a spring scale, a paper clip, a strip of tape, 2-3 pencils, 23 sheets of paper, two pieces of waxed paper, one pair of scissors, and 1 of the objects saved from the previous lesson.

6. Tell the students to copy the chart on page 134 before doing the experiment. Remind them to read the directions and explanations in their books carefully.

7. Provide help as it is needed. The students can tape the waxed paper to keep it around the objects during the experiment.

8. Have the students discuss their findings in terms of forces. A larger force is needed to start an object moving and to stop a moving system. Less force is needed to keep an object moving at the same speed.

9. If there is substantial disagreement about results, have students demonstrate their methods of doing the experiment while the class watches. The class may observe a variable that was inadvertently added to the system.

10. Have the students save their charts for use in Lesson 3.

DESIRED LEARNING OUTCOME: Ability to describe differences in the amount of force needed to start an object moving and to keep it moving, and to identify some variables affecting motion.

****

DEVELOPMENT: Lesson Cluster 2C-1 Putting Forces to Work
Page T-229/S-135 Friction (35 min.)

PURPOSE: Extend the investigation of variables that affect motion to friction as a force that opposes motion.

Language Cards/Key Signs
friction
interact

ADVANCE PREPARATION:

Background Information: Friction is the force that acts when two objects or surfaces are in contact or rub against each other. On Earth, friction can keep objects from moving or stop objects that are in motion. In space, there is very little friction on the outer surface of a space vehicle because there is very little matter opposing its motion. (Of course, friction would still be produced by objects interacting inside a space vehicle.) A force is needed to cause an object in space to change direction, but no force is neadod to keep the object in motion.

Materials -2 blocks of wood, any size
-magnifying glass
-a piece of wax paper

TEACHING SUGGESTIONS:

1. Use the 2 blocks of wood to demonstrate 2 objects interacting as is explained on page 135.

2. Use the magnifying glass to show the student the roughness of the surface. Explain that this roughness causes friction when the 2 objects interact.

3. Using the magnifying glass, compare the wood surface with the wax paper surface.

4. At this point, have the students read the introduction on page 135.

5. Be sure the students understand that friction is a force that acts when objects are in contact or rub against each other. Friction can prevent or stop the motion of the objects.

6. Have the students read the rest of the lesson and answer the questions. You may want to demonstrate the interaction and friction again with the blocks.

7. After they discuss the italicized questions, ask the students to take out the charts that they made in the previous lesson. Have them place their charts under the listed steps on page 134 so that they can easily refer to the steps. Then ask the students to describe the effect of friction in each of the steps.

8. Have the students describe the effect of friction on the objects shown on pages 132 and 133.

9. Discuss the numbered questions with the students. In the discussion of question 1, be sure the students realize that without friction objects would slip and slide freely. Any objects that slid past the edges of their desks would fall to the floor because of the force of gravity.

DESIRED LEARNING OUTCOME: Ability to describe friction as a force that opposes motion.

****

DEVELOPMENT: Lesson Cluster 2C-1 Putting Forces To Work
Page T-230/S-136 Changes Directions (50 min.)

PURPOSE: Extend the investigation of the variables that affect motion to comparison of forces needed to move objects in different directions.

ADVANCE PREPARATION: Materials -Have the following for each group of 2-3 children:
-1 spring scale
-1 jumbo paper clip
-2-3 pieces of paper and pencils
-1 scissors
-6 metal washers
-transparent tape
-1 set of 3 thick books
-1 large thin book

TEACHING SUGGESTIONS:

1. Have the students turn to page 136 and read the introduction to find out what the lesson is about. Teacher may paraphrase.

2. Emphasize that they are going to investigate forces needed to move objects in different directions.

3. Divide the class into groups of 2 or 3.

4. Distribute the paper and pencils and have the students make a chart according to the directions in the lesson.

5. Distribute washers, paper clips, and a strip of tape to each group.

6. Have the groups make their packets of washers according to the direction at the top of column 2 when they complete their charts. Tell them to be certain that there is no tape sticking out over the edges of their packets that could catch on a surface.

7. Distribute the spring scales and picture books and have the groups do steps a, b, and c on page 136. If necessary paraphrase the steps.

8. Have each group get their set of three books, make their book "hills" according to the directions on page 137, and complete the lesson. Be sure that the students use their picture books for the "hill".

9. Have the students discuss their findings, step by step. The probable outcomes are as follows:
   a. The students will be unable to find a measurable difference between the forces necessary to lift the packet and to keep it moving.
   b. The force measured here should equal the weight of the packet. The students should realize that the force of gravity (the packet's weight) causes the packet to move straight down.

c. This experiment essentially repeats those in previous lessons. The students' results will vary as the textures of the books they used as surfaces differ. Have the students discuss how friction prevented or stopped the motion of the packet.
d. It requires a lot of force to move the packet up the "hill" at a constant speed.
e. It requires less force to move the packet down the "hill" than it did to move it up the "hill."

10. Have the students compare their results in Step a and in Step d. This will bring out the major learning of the lesson: It requires less force to move an object uphill than it does to lift it straight up.

11. Discuss the numbered questions with the students.

DESIRED LEARNING OUTCOME: Ability to compare the force needed to pull an object uphill and the force needed to lift the object straight up.

****

DEVELOPMENT: Lesson Cluster 2C-1 Putting Forces To Work
Page T-232/S-138 The Inclined Plane (20 min.)

PURPOSE: Extend the investigation of moving objects to the formal introduction of the inclined plane.

ADVANCE PREPARATION:

Background Information: The inclined plane is a simple machine because it is a device to change the amount and direction of force in order to move an object more easily. Sliding or rolling an object up an inclined plane is easier than lifting it straight up. However, the use of an inclined plane requires that the object be moved a greater distance.

Language Cards/Key Signs
inclined plane
simple machine

Materials - none

TEACHING SUGGESTIONS:

1. Remind the students that they found in the previous lesson that it requires less force to pull an object up a hill than it does to pull (lift) it straight up. Tell them that knowing this can be very useful when large, heavy objects have to be moved.

2. Have the students turn to page 138, read the lesson, and answer the question. Teacher may paraphrase.

3. Discuss the lesson with the students. Emphasize that a simple machine is anything that makes it easier to use a force to move something. Stress the convenience of using an inclined plane.

4. Be certain the students understand that pulling an object up an inclined plane means that the object must be pulled a greater distance. To pull the object the extra distance, however, requires less force. Ask the students why they think it might be worth it to pull the object the extra distance.

5. Discuss the numbered questions at the end of the lesson. Do not be concerned if the students cannot identify many inclined planes. The next lesson highlights applications of the inclined plane.

DESIRED LEARNING OUTCOME: Ability to describe an inclined plane as a useful simple machine.

****

APPLICATION: Lesson Cluster 2C-1 Putting Forces To Work
Page T-233/S-139 Inclined Planes (25 min.)

PURPOSE: Extend the knowledge of inclined planes to everyday applications.

ADVANCE PREPARATION: None

TEACHING SUGGESTIONS:

1. Review the inclined plane as a simple machine.
2. Have the students turn to page 139 and do the lesson. Teacher may paraphrase.
3. After they have studied the pictures, ask the students if they can think of additional inclined planes in everyday life.
4. Discuss the numbered questions with the students in the context of applying force to move objects.
5. You can extend the lesson by asking students to bring in pictures from magazines that show inclined planes. If you prefer, they can draw pictures that show uses of inclined planes. Make a bulletin board display of the pictures that they bring in or draw. Have a student make a sign "Simple Machines" to pin above the pictures.

DESIRED LEARNING OUTCOME: Ability to describe some examples of inclined planes in everyday life.

****

APPLICATION: Lesson Cluster 2C-1 Putting Forces To Work
Page T-234/S-140 Wedges (30 min.)

PURPOSE: Apply knowledge of simple machines to the wedge.

ADVANCE PREPARATION: None

Language Cards/Key Signs
wedges
simple machines

TEACHING SUGGESTIONS:

1. Explain to the students that in this lesson they are going to learn about another simple machine. Have the students turn to page 140, read the lesson, and study the pictures.
2. Discuss the pictures with the students. If they have difficulty in identifying the wedge shown in any picture, tell them to look carefully for a shape like the wedge in the drawing.

3. Explain that a wedge is an inclined plane that is used as a moveable tool. It used forces to push or press aside objects. (The wedge pushes the object at about 90 to the direction of the movement of the wedge.) A wedge is pushed under or between two objects.

4. Have the students look at the pictures while you explain that it requires a comparatively long push (distance moved) of the wedge to cause a comparatively small side push (force) on the objects. Relate this to the greater distance an object must be pulled up an inclined plane.

5. Ask the students to bring in pictures from magazines or to draw pictures that show wedges. Add these pictures to the bulletin board display of simple machines.

DESIRED LEARNING OUTCOME: Ability to describe a wedge as a simple machine that is used to press or push an object sideways.

****

EVALUATION: Lesson Cluster 2C-1 Putting Forces To Work
Page T-235/S-141 Comparing Forces (30 min.)

PURPOSE: Evaluate the students' perfromance in relation to the following objective:
1. Ordering, from greatest to least, the amount of force needed to keep various objects moving.

ADVANCE PREPARATION: Materials -paper
-pencil
-textbook

TEACHING SUGGESTIONS:

1. Have the students read through page 141.

2. Have the students proceed with the lesson when you are sure that they understand what they are to do. It may be helpful to go over the picture with the students, making sure they see each number and know what each person is doing.

3. Go over the students' responses with them when they have completed their work. The students are not expected to get every single force in order. Much will depend on such interpretation of the drawing as is the man going up or down the ladder. The students should, however, be able to give reasons for their choices

4. Let the students correct their own papers, if you wish, so that they may evaluate their own progress.

5. Collect the papers so that you can evaluate each individual's progress. If a student has correctly ordered all or most of the forces, you may assume that he or she has demonstrated the objective for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 2 Forces

Part C Simple Machines, Lesson Cluster 2C-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-240	Introduction	Energy Transfer	30 min.
T-241	Development	Energy Transfers with Inclined Planes	25 min.
T-242	Development	A Paper Dragon	50 min.
T-244	Application	Changing the Paper Dragon	50 min.
T-246	Application	Changing the Other Variables	40 min.
T-248	Evaluation	A Research Project	50 min.

B. MATERIALS: Add the following to the Materials List on Page T-237:
- -several marbles or balls
- -1 set of 3 thick books and 1 thin large book for inclined plane structure
- -1 ball
- -1 block of wood

FILMSTRIP INFORMATION: Filmstrip Set XVI, Pushes & PUlls, is appropriate for use in this unit.

INTRODUCTION: 2C-2 Working with Inclinded Planes
Page T-240/S-142 Energy Transfer (30 min.)

PURPOSE: Review the concepts of energy transfer, energy giver and energy receiver.

ADVANCE PREPARATION:

Background Information - When unbalanced forces cause motion, the object(s) set in motion acquires energy. When you lift an object, you do so against the force of gravity. Energy is stored in the object and is available for transfer when you release the object.

Language Cards/Key Sign
energy transfer
energy giver
energy receiver
transfer

Materials: - several marbles, balls or any other objects suitable for demonstrating energy transfer.

TEACHING SUGGESTIONS:

1. Introduce the cluster by explaining to the students that they are going to learn more about inclined planes and what can happen to energy in a system.

2. Have the students turn to page 142 and read the first 2 paragraphs. Teacher may paraphrase.

3. Use the marbles, balls, etc. to demonstrate energy transfer to the class. Explain that the moving marble is the energy giver and those marbles that were caused to move are the energy receivers.

4. Students should complete reading page 142 and answer the questions.

5. Plan a more thorough discussion if the concept of energy transfer from an energy giver to an energy receiver is new to the students. Students who have done the fourth-level unit Exploring Energy, will be familiar with these concepts.

6. Emphasize that energy is required in any interaction and that energy is transferred during the interaction.

7. Discuss the questions with the class. In answering question 1, let the students freely express their opinions. It is all right if they cannot trace the energy back to the original source. They will deal further with sources of energy later in the cluster.

DESIRED LEARNING OUTCOME: Ability to describe energy transfers from energy givers to energy receivers.

****

DEVELOPMENT: 2C-2 Working with Inclined Planes
Page T-241/S-143 Energy Transfers With Inclined Planes (25 min.)

PURPOSE: Introduce the concept that an inclined plane can be used to control the direction and force of a rolling object.

ADVANCED PREPARATION:

Background Information - When a ball rolls down an incline, the force moving it is its weight. If the ball drops straight down, the force is at a maximum. If the ball rolls down an incline, some of the force is directed into the plane that causes the ball to roll down. The closer the incline is to the vertical, the greater the force causing it to move and the faster it goes.

Language Cards/Key Sign
energy transfers
inclined planes
direction
force

It might be useful to draw three inclines to visualize the situation. Draw one as a vertical line, one at a 45 angle, and one as a horizontal line. A ball "rolling" down the vertical plane will have all of the force on it pulling straight down and will travel at maximum speed. A ball on a horizontal plane will have the total force directed into the plane and will not move. A ball on the 45 incline will have half the force directed into the plane and half parallel. Thus the ball will achieve about one-half the speed that a ball dropped straight down achieves. When the angle of the inclined plane changes, there is a corresponding change in speed.

Materials: - a set of 3 thick books and 1 think large book
- 1 block of wood
- 1 ball

TEACHING SUGGESTIONS:

1. Have the students read page 143. Teacher may paraphrase.
2. Use the books, ball and block to demonstrate the use of the inclined plane as described in the text and picture on page 143.
3. Discuss the transfer of energy in the moving-ball system. Emphasize that the ball first must be lifted (be given energy) into a position from which it can fall under the force of gravity.
4. Draw a parallel between dropping a ball and rolling a ball down an inclined plane. Explain that the plane causes the ball to "drop" in a different direction.
5. Discuss the numbered questions. In question 1, the hand supplies energy to the ball. The ball also is an energy giver, because it supplies energy to the block. The ball and block are both energy receivers.
6. Help the students understand, when discussing question 2, that the ball exerts less force rolling down the plane.
7. Emphasize that an inclined plane can be used to control the direction and force of a "falling" object. Use playground slides as an example.

DESIRED LEARNING OUTCOME: Ability to identify the energy givers and receivers in an inclined plane system.

****

DEVELOPMENT: 2C-2 Working With Inclined Planes
Page T-242/S-144 A Paper Dragon (50 min.)

PURPOSE: Extend learning about energy transfer in moving systems to an investigation of the variables that affect such a system.

Language Cards/Key Sign
paper dragon
variables
system
friction

ADVANCE PREPARATION: Materials - Have the following for each pair of students:
- 1 file card 7.5 cm x 12.5 cm (3 in. x 5 in.)
- 2 marbles
- 1 set of 3 books
- 3 pieces of lined paper 23 cm x 30.5 cm (9 in. x 12 in.)
- scissors
- 2 pencils
- crayons, assorted colors

TEACHING SUGGESTIONS:

1. Have the students turn to page 144 and read through the lesson to find out how they are going to make "paper dragon" systems. Teacher may paraphrase.

2. Divide the students into pairs and have them get their materials. Then have them set up the dragon systems.

3. Allow time for the students to practice rolling the marble down the center crease of the open book and observing how many lines the "paper dragon" moves.

4. Have the students start the experiment. They will probably concentrate on angle and launch-position variables, but encourage them to look for others. Stress that they are dealing with a system that involves many factors.

5. Have the students discuss the numbered questions on page 145.

6. List on the chalkboard the energy transfers that the students name in response to question 1. The energy can be traced from the hand to the marble to the "dragon" to the lined paper on the desk top. In each part of the transfer the first object acts as energy giver and the second as energy receiver. Students who have done the fourth-level unit Exploring Energy will probably remember that two or more energy transfers in a system is called an energy chain.

7. Ask the students if they remember how to write energy chains using words and arrows. Write or have a student write an energy chain for the "paper dragon" system on the chalkboard:

   hand   motion   marble   motion   "dragon"
   heat   paper

8. Review the term friction if the students have difficulty in answering question 2.

9. Review or introduce the concept of energy transformation when the students discuss question 3. Help them to understand that energy may be changed from one form to another in an interaction. In the paper dragon system, some of the energy of motion was transformed to heat energy because of friction. The book surface and the marble rubbed together and both became warmer.

10. Have the students save their "dragon" systems for use in the next 2 lessons.

DESIRED LEARNING OUTCOME: Ability to describe energy transfers that move an object in an inclined-plane system and name at least 2 variables that affect the system.

APPLICATION: 2C-2 Working With Inclined Planes
Page T-244 Changing the Paper Dragon (50 min.)

PURPOSE: Enable the students to apply their knowledge of variables to the effects of changing the weight of the energy receiver in an inclined plane system.

ADVANCE PREPARATION: Materials - For each pair of students you will need:

- "paper dragon" systems from previous lesson
- 3 pieces of lined paper
- 2 pencils
- 4 paper clips, size #1

Language Cards/Key Sign
variable
constant
reliable

TEACHING SUGGESTIONS:

1. Divide the class into the same pairs that worked together in the last lesson. Have the students read page 146 to find out how they are going to change their "paper dragon" systems. Teacher may paraphrase.

2. Ask the students what variable in the "dragon system" they will be changing by adding paper clips to the "dragon." Help them to understand that they are changing the weight of the energy receiver and, therefore, the amount of friction between the "dragon" and the paper surface it slides on.

3. Distribute three sheets of paper to each pair of students. Have them number the lines on the sheet that will be used as the surface paper in the "dragon" system.

4. Have the students read as far as the numbered questions on page 147.

5. Explain to the students that a variable that will not be changed is called a constant. The list on page 147 is a list of the constants in the experiment.

6. Provide time for the students to copy the list of constants at the top of the second sheet of paper and the chart at the bottom. To save time, have one student in each pair copy the list of variables and the other copy the chart.

7. As an option, the teacher may paraphrase the list into simpler terms and write it on the board or transparency. Explain to the class that these constants simply mean that the inclined plane is not going to change in any way. After this explanation is clear, have the students copy the chart on 147.

8. Be certain that the students understand that they are to keep all variables the same except the weight of dragon.

9. Have the students do the experiment.

10. Introduce the term reliable before the numbered questions are discussed. Write the term on the chalkboard. Explain that reliable results in an experiment are results that can be depended on because they appear over and over, "try" after "try." Results that differ most of the time are unreliable.

11. Have the students discuss the numbered questions.

12. Have the students save their lists of variables for use in the next lesson.

DESIRED LEARNING OUTCOME: Ability to determine how changing the weight of an energy receiver in an inclined plane system affects how far it will move when all other variables are constant.

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APPLICATION: 2C-2 Working With Inclined Planes
Page T-246/S-148 Changing Other Variables (40 min.)

PURPOSE: Investigate two additional variables in an inclined plane system - the distance a moving object must roll down a plane and of the angle of the inclined plane.

ADVANCE PREPARATION: Materials - Have the following for each pair of students:
- "paper dragon" systems
- lists of variables from previous lesson
- 1 metric ruler
- 2 pencils
- 2 pieces of lined paper

TEACHING SUGGESTIONS:

1. Remind the students that in the previous lesson they changed the energy receiver. In this lesson they will experiment with the energy giver in their inclined plane system.

2. Ask the students to take out their lists of variables from the last lesson.

3. Divide the class into pairs.

4. Have the students read page 148 to find out what variables they are going to change in their experiment. Teacher may paraphrase.

5. Distribute sheets of paper to each pair of students.

6. Have one student in each pair revise the list of constants by crossing out "a" (point on theplane at which the marble starts to roll) and adding the variable that will become a constant (the weight of the energy receiver) to the list of variables. Have the other student copy the chart. Which ever student finished first can number the lines on the "surface" paper.

7. As an option, as in previous lessons the teacher may write a list of constants on the board rather than having the students write their own lists.

8. Be certain that the students understand how to keep constant all the variables but the distance that the marble rolls.

9. Have them do the experiment and record their results.

10. Have the students go on to the second part of the lesson as they are ready. Remind them to revise their lists of constants before they begin the next experiment, or the teacher should revise the list on the board. They should cross out "b" on their lists and make "a" a constant again. Also remind them to copy the chart.

11. Discuss the numbered questions with the students. Ask them how they could tell that each variable they changed gave more energy to the marble. Help them to understand that the "dragon" moved a greater distance when it received more energy. That increase in energy was transferred to the "dragon" by the energy giver (the marble).

12. Have the students keep their "dragon" systems for use in the next lesson.

DESIRED LEARNING OUTCOME: Ability to determine how changing the length and slope of an inclined plane system affects the amount of energy available for transfer in the system.

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EVALUATION: 2C-2 Working With Inclined Planes
Page T-248/S-150 A Research Project (50 min.)

PURPOSE: To evaluate the student's performance in relation to the following objectives:

1. Constructing an inclined plane system to move an object.
2. Changing and controlling variables in order to produce a predictable and reliable system.

ADVANCE PREPARATION: Materials - For each pair of students have the following:
- 2 pieces of lined paper
- 2 pencils
- "paper dragon" systems
- 4 paper clips, size #1

TEACHING SUGGESTIONS:

1. Have the students turn to page 150 and read through both pages of the lesson. Teacher may paraphrase.

2. Be certain that they understand what they are to do. Answer questions other than those that pertain to how to design the system.

3. Divide the class into pairs that are different from those that previously worked together.

4. Distribute the materials and have them do the lesson.

5. Move among the students as they work. Informally observe individual contributions to the project. Evaluate the progress of students who may have had difficulty with earlier work in the cluster.

6. Announce the exact number of lines that the paper "dragon" is to move when most of the students have succeeded in moving the "dragon" the required 15 lines. Choose a number other than 15.

7. Tell the students to stop when exactly five minutes are up.

8. Tell the students that before you can "award the compant contract," they have to show you how reliable their inclined plane systems are. Have each pair of students release the marble or marbles in their system just one time while you observe.

9. Have the students discuss the variables and constants in the systems that they constructed.

10. Determine individual progress from your observations. If a student actively participated in the construction of the inclined plane system and in the determination of the variables or constants in the system, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster. Students do not "fail" the cluster if they are unable to meet the requirements of the "research company" within five minutes.

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Level 5 Unit 2 Forces

Part C Simple Machines, Lesson Cluster 2C-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-254	Introduction	Making a Lever	45 min.
T-256	Development	Measuring Level Action	30 min.
T-258	Development	Making a Balance	50 min.
T-261	Development	Balancing Forces	40 min.
T-262	Application	Using Levers	30 min.
T-264	Evaluation	Balancing Levers	30 min.

B. MATERIALS - Use Materials List on page T-251.

FILMSTRIP INFORMATION: Filmstrip Set XVI, Pushes & Pulls, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2C-3 Levers
Page T-254/S-152 Making a Lever (45 min.)

PURPOSE: Introduce the concept of lever.

ADVANCE PREPARATION: Materials - For each pair of students have the following:
- 2 pieces of cardboard, such as backs of pads of paper (20 cm x 4 cm) (8 in x 11½ in)
- 1 metric ruler
- 1 pencil
- 1 scissors
- 1 piece of graph paper, 23 cm x 30.5 cm (9 in x 12 in)

Also have on hand:
- several paper hole punchers
- glue or paste

Language Cards/Key Signs
lever
simple machine
fulcrum

TEACHING SUGGESTIONS:

1. Introduce the cluster by reminding the students that they have already studied two kinds of simple machines - inclined planes and wedges. They are now going to construct and work with another kind - levers.

2. Have the students read the introduction on page 152 to review the concept of simple machines. Teacher may paraphrase.

3. Divide the class into pairs.

4. Have the students read the directions for making a lever on page 152 and the first column of page 153.

5. Caution the students to work slowly and carefully, one step at a time. It is important that the punched holes on both cards line up and are properly spaced.

6. Have the students get their materials and begin to make the levers.

7. If necessary, the teacher may make a lever during class (to help clarify instructions) for demonstration.

8. Suggest that one student punch out half the holes while another holds the cardboard steady and then switch positions. The students may need assistant with this step.

9. Allow the students sufficient time for making levers. Point out that the staples or glue used to hold the lever together must be evenly distributed on both sides of the zero hole.

10. Check completed levers to see that the holes are aligned and numbered correctly.

11. Have the students read the directions at the top of the second column on page 153. If any of the students need additional time and help with constructing a lever, work with them while the others go on with the rest of the lesson. (A tighter fulcrum with less play can be achieved by using the eraser end of the pencil instead of the point.

12. Discuss the italicized questions. The students probably discovered quickly that the right end goes down when the left end is pushed up, and the right end goes down a different distance when they put the pencil in a different hole.

13. Be sure that the students understand the term fulcrum. See Glossary for definition.

14. Discuss the numbered questions. Be certain the students understand that the force in the lever system comes from pushing the lever. Question 1 will help the students to understand that the lever - a simple machine - changes the direction of the force. Question 2 will help them to understand that changing the fulcrum affects how the force changes.

15. Have the students save the levers and graph paper for the next lesson.

DESIRED LEARNING OUTCOME: Ability to describe and observe how a lever changes the direction of a force.

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DEVELOPMENT: Lesson Cluster 2C-3 Levers
Page T-256/S-154 Measuring Lever Action (30 min.)

PURPOSE: Measure how much a lever changes the direction of a force as well as how much that change is increased by changing the fulcrum.

ADVANCE PREPARATION: Materials - Have the following for each pair of students:
- 1 pencil
- 1 piece of graph paper
- 1 piece of writing paper
- lever from Making a Lever

Language Cards/Key Sign
levers
fulcrum

TEACHING SUGGESTION:

1. Have the students read page 154 to find out what they are going to do. Teacher may paraphrase.

2. Explain that by using graph paper they will be able to measure the actual distance one end of the lever moves when the other end is pushed.

3. Divide the students into pairs and have them get their materials.

4. Suggest that one student in each pair copy the chart and the other number the graph paper.

5. Have the students discuss their results and the numbered question. They should see immediately that the distance one end of the lever moves changes when the fulcrum is changed.

6. Have the students who are interested experiment with placing the fulcrum in different positions.

DESIRED LEARNING OUTCOME: Ability to measure how much a lever changes the direction of a force and also the change in amount of movement caused by changing the fulcrum.

****

DEVELOPMENT: Lesson Cluster 2C-3 Levers
Page T-258/S-155 Making a Balance (50 min.)

PURPOSE: Use a lever as a balance and to measure for different fulcrums, the force needed to balance another force exerted in any given point on a lever.

ADVANCE PREPARATION:

Background Information - A lever can exert a larger force over a small distance or a smaller force over a greater distance, depending on where the fulcrum is located. Moving large boulders is an example of exerting a great force over a small distance. Using a fly-casting fishing rod is an example of exerting a small force over a great distance. The aim is to cast the lure a great distance with a short motion of the hand.

Language Cards/Key Sign
balance
fulcrum
lever

The students will discover in this lesson and in the next one that a small force exerted over a greater distance on a lever can balance a larger force exerted over a short distance. In lesson 5, they will examine some practical applications of levers.

Materials: For each pair of students have the following:
- 2 paper clips, jumbo
- 1 pencil
- lever
- 1 piece of writing paper
- 1 wire coat hanger
- 1 book
- 4 metal washers
- 1 spring scale
- masking tape

It is recommended that you prepare the hangers ahead of time. (See picture A on page 155.) Prepare one hanger and then determine if you want the students to bend their own or not. First bend the ends of the hanger. Then twist the hook in the opposite direction, bend it over, and then very slightly straighten it out. Tape over any exposed sharp points on the hanger as a safety measure.

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that they are going to use the levers to make balances.

2. Review the term balance. Balances were introduced earlier in this unit in Measuring Mass (page 113). Students who have done the fourth-level unit patterns are familiar with the concept of balance and have experimented with a balance beam.

3. Divide the students into pairs.

4. Have the students read page 155 and look at the pictures to find out how they are going to make a balance. Teacher may paraphrase.

5. Have the students get their materials and begin to work. Tell the students to be sure that the book is placed far enough back so it will not obstruct washers hanging from the balance.

6. Check the washers first if the balance does not balance with washers at R9 and L9. They can vary enough to throw off the balance. If that does not prove to be the problem, check the spacing of the holes on the lever, the hanger, the symmetry of the lever, and how the staples and/or glue are spaced.

7. Have the students look at picture B and help them use the spring scale to measure the amount of the force. Be certain the students understand that they have to hold and read the scale upside down.

8. Discuss the italicized questions with the students. Be sure the students understand that with washers pulling down on one end of the lever, the force on the other end is directed upward. This change in direction is one of the primary functions of a simple machine.

9. Go over the directions for changing the fulcrum to R2 on the bottom of page 155 and have the students do the experiment.

10. Discuss their responses to the italicized questions. Students will probably observe immediately that it requires less force on the long end to balance the lever. Ask the students if they think there is a connection between the length of the long end of the lever and the force needed to balance the force on the short end. Ask them to keep this question in mind as they do the next experiment.

11. Tell them that in the next experiment they will measure how much changing the fulcrum changes the size of the force.

12. Have the students read through the directions on page 156 to make sure that they know what to do.

13. Have the students do the experiment. They should experiment freely with the balances, varying the fulcrums and the number of washers before they fill in the chart.

14. As an option, this experiment may be done by the teacher with the entire class. In this case, the chart should be copied on the board or transparency and one balance will be used. The students can participate by manipulating the balance, making readings and recording them on the board.

15. They will be unable to get a reading for any number of washers with the fulcrum at R8, or for one or two washers with the fulcrum at R5, or for one wash with the fulcrum at R2.

16. Ask the students if they can observe a pattern emerging as they record their readings. (The decreasing force necessary at L9 to balance the lever as the fulcrum is moved farther to the right.) Again ask them about the relation between the force necessary to balance on the long end (L9) and the distance from the fulcrum. A force acting over a short distance from the fulcrum (the right end) can be balanced by a smaller force acting over a long distance on the other end of the lever.

17. Discuss the numbered questions with the students.

18. Draw a balance on the board and indicate the forces with arrows when the students discuss question 1. Ask if the arrows for pushes point in the same directions as the arrows for pulls (Go back to previous page for #14.).

19. Discuss question 2 in some detail so that the students can begin to see the practical application of this principle. Emphasize that the value of the lever as a simple machine is that by changing the fulcrum you can choose to exert less force over a longer distance or more force over a shorter one, depending upon what you want to balance or move.

20. Extend question 2 by substituting a large boulder for the heavy person. Draw a diagram of the seesaw on the board, with the short end on the left. Then ask "If you wanted to balance the boulder using as little force as possible, would you put the boulder on the long or short end?" (The short end.)

21. Have the students store their balances in a safe place, ready for the next lesson. Have them save their data charts for use in lesson 4, as well. If done as a class activity make a copy of the chart before erasing it from the board, or save transparency.

DESIRED LEARNING OUTCOME: Ability to use a lever as a balance to measure for different fulcrums, how much force is needed to balance another force exerted at any given point on the lever.

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DEVELOPMENT: Lesson Cluster 2C-3 Levers
Page T-261/S-157 Balancing Forces (40 min.)

PURPOSE: Measure the force needed to balance another force on a lever with a constant fulcrum.

Language Cards/Key Signs
balance
forces
fulcrum
constant

ADVANCE PREPARATION: Materials - For each pair of students have the following:*
- 1 pencil and piece of paper
- lever
- 1 paper clip, jumbo
- 4 metal washers
- 1 spring scale
- chart from previous lesson

*This experiment may also be done as a class activity as in the previous lesson. If you choose this option, only one set of the above materials will be needed.

TEACHING SUGGESTIONS:

1. Have the students turn to page 157 and read the introduction to find out what they will do with their levers in this lesson.

2. This lesson may either be done in pairs or as a whole class acitivty as in previous lesson. If done as a class, the chart will be copied on the board or transparency and only one set of materials will be used. Students will participate by making measurements and recording results under the teacher's direction.

3. If the students are going to work in pairs, have them take out the charts that they saved from the last lesson.

4. Have the students get their levers and other materials and do the lesson.

5. Discuss the students' responses to the questions. The students will probably have observed that, with a constant force on one end of a lever and a constant fulcrum, the size of the force required on the other end to balance the lever decreases as the force is applied farther away from the fulcrum.

6. Ask the students where a small person would sit on a seesaw in order to balance the seesaw if a heavy person were sitting close to the fulcrum on the other side. Would the small person sit next to the fulcrum? In the center? On the end? (On the end.) If there is a seesaw available (perhaps in a nearby playground) it would be helpful to demonstrate these principles directly.

DESIRED LEARNING OUTCOME: Ability to measure the size of the force needed to balance another force exerted on a lever with a constant fulcrum, and determine that the size of the force depends on the point at which the force is applied.

****

APPLICATION: Lesson Cluster 2C-3 Levers
Page T-262/S-158 Using Levers (30 min.)

PURPOSE: Apply the knowledge of levers to levers used in everyday activity.

ADVANCE PREPARATION: Materials - The following materials optional:
- scissors
- nut cracker and nut
- bottle opener and bottle

Language Cards/Key Signs
levers
fulcrum

TEACHING SUGGESTIONS:

1. Facilitate the students' understanding of how levers can be applied to everyday tasks by reviewing what students have learned about levers:
   a. As a simple machine, a lever can change the size and direction of forces.
   b. When the fulcrum is near one end of a lever, a large force can act over the short distance when a small force acts over the long distance.

2. Draw simple diagram of a seesaw and large boulder on the board with the boulder on the shorter end. Ask the students where on the longer end they would place a small boulder to balance the lever. Next to the fulcrum? In the center? On the end? Ask them if the forces are then balanced. (They are.) Then ask on which side a large force is acting over a short distance and on which side a small force is acting over a larger distance. Explain that the same principle can be used not only to balance objects but also to move them. Ask them if they wanted to raise or "lift" the large boulder, in which direction they would move the small one. Closer to the fulcrum? Farther away from the fulcrum?

3. Tell the students that there are many different kinds of levers. Where the fulcrum of any lever is located depends on the job it is designed to do.

4. Have the students do page 158. Teacher may paraphrase.

5. In addition to the pictures, the teacher may find it helpful to demonstrate with the actual levers, i.e., scissors, nut cracker, bottle opener.

6. Have the students discuss all the questions. Remind the students, if they have difficulty in identifying the short distance on the nutcracker, that in their experiments with balances they placed the fulcrum almost at the very end of the lever. The nutcracker situation is similar.

7. Have the students turn to page 159. and continue with the lesson. Remind the students that the force is supplied by the person in each picture. To locate the fulcrum of each object the students must recognize that the fulcrum is the pivot point of a lever. The lever may be supported or held in place at its fulcrum.

8. Discuss page 159 with the students. Emphasize with the students that a lever allows a person to move an object more easily by changing the size or direction of a force. If they keep this function in mind, they should be able to focus on that point of a lever that "does the job."

DESIRED LEARNING OUTCOME: Ability to describe several everyday applications of the lever as a simple machine.

****

EVALUATION: Lesson Cluster 2C-3 Levers
Page T-264/S-160 Balancing Levers

PURPOSE: To evaluate the students' performance in relation to the following objective:

1. Ordering a set of levers on the basis of the force advantages they provide.

PREREQUISITE: Ability to sequence from most to least.

ADVANCED PREPARATION: Materials - paper, pencil and text

TEACHING SUGGESTIONS:

1. Have the students turn to page 160 and read through the lesson. Teacher may paraphrase.

2. Have them proceed with the lesson when you are certain that they understand what they are to do.

3. Go over the responses with the students when they have completed their work. You may wish to let the students correct their own papers so that they may evaluate their own progress.

4. Collect the papers so that you can evaluate each individual's progress. If a student correctly orders the levers on the basis of the force exerted on the spring scale, you may assume that he or she has demonstrated the objective of the cluster and is ready to go on to the next cluster.

5. For further informal evaluation, have the students turn back to page 131 and look at the picture that introduces Part C. Ask them why they think that particular picture was used to introduce the part that they have just completed. Suggest that they look for clues in the part title and in the cluster titles on pages 132, 142, and 152. The students should be able to:
    a. identify the launching ramp, the bow of the boat, and the oars as simple machines.
    b. identify the launching ramp as an inclined plane and the oars as levers.
    c. infer that friction occurs between the oars and oarlocks.
    d. infer that energy is being transferred from the person to the oars.
    e. infer that the interaction between the oars and the water transfers energy from the person to the board, causing the boat to move.
    f. infer that the amount of force the person transmits to the oars determines the speed of the boat.

****

Level 5 Unit 3 Motion

Part A Relative Motion, Lesson Cluster 3A-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-274	Introduction	Evidence of Motion	20 min.
T-275	Development	Reference Objects	20 min.
T-276	Development	Relative Motion	20 min.
T-278	Development	Using Reference Objects	45 min.
T-277	Enrichment*	What Moved?	25 min.
T-280	Application	What Is Moving?	30 min.
T-281	Evaluation	Identify the Movers	30 min.

B. MATERIALS: Add the following to the Materials List on page T-271 -
- 1 brightly colored object such as a ball or book

FILMSTRIP INFORMATION: Filmstrip Set VII, Place and Motion, and XV, Relative Motion, are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3A-1 Objects and Motion
Page T-274/S-163 Evidence of Motion (20 min.)

PURPOSE: Review or introduce the concept of motion and the need for using reference objects in describing motion.

ADVANCE PREPARATION:

Language Cards/Key Signs
evidence
motion

Background Information: Motion is a continuous change in position. The change in position is evidence that an object has moved. The only way to determine if an object has changed position is to compare its position to that of other objects. Students who have studied Level 3 of the program should be familiar with this.

Materials: 1 brightly colored object such as a ball or book

TEACHING SUGGESTIONS:

1. Select a brightly colored object, such as a ball or book, face the class and slowly move the object in front of you from left to right. Ask the students if the object is moving and how they can tell if it is moving. After the students have given their own opinions and explanations, tell them that it is not always easy to determine whether or not an object is moving. Continue with the lesson without reaching a definite conclusion.

2. Have the students turn to and read page 163. Teacher may paraphrase. Ask them to study the pictures carefully and answer the italicized questions.

3. Discuss the italicized and numbered questions with the students. They should be able to determine that the bicycle in picture B has moved compared to its position in picture A, but some students may have difficulty in explaining how they know that the bicycle moved. Help them to realize they know that the only way they can tell is that the position of the bicycle in relation to the house and tree has changed from picture A to picture B.

4. Repeat your earlier demonstration of moving an object from left to right, but this time move the object over some vertical object such as a bookend on your desk. Again discuss with the students how they can tell that the object is moving. The students should be able to recognize the importance of a reference object in describing motion.

DESIRED LEARNING OUTCOME: Ability to determine wehther or not an object has moved in relation to other objects.

****

DEVELOPMENT: Lesson Cluster 3A-1 Objects and Motion
Page T-275/S-164 Reference Objects (20 min.)

PURPOSE: Extend the concept of motion by reviewing or introducing the term reference object.

ADVANCE PREPARATION: Materials - none.

Language Cards/Key Signs
reference objects
motion

TEACHING SUGGESTIONS:

1. Have the students read the introduction to the lesson on page 164 either to review or to find out what a reference object is. Teacher may paraphrase.

2. Discuss with the class the importance of reference objects. Emphasize that the motion of an object can be described only in relation to other subjects. Encourage the students to use the term reference object in this lesson and in the lessons throughout the cluster.

3. Have the students look at the pictures on page 164 and answer the questions.

4. Go over the students' responses with them when they have completed the lesson.

5. Reinforce the use of reference objects to describe the motion by asking students to move a series of objects in the room and challenging other students to describe the motion.

6. Ask the students how they would change pictures C and D on page 164 to show that the girl and bicycle had moved.

DESIRED LEARNING OUTCOME: Ability to describe motion by using reference objects and determine that motion cannot be described without the use of reference objects.

****

DEVELOPMENT: Lesson Cluster 3A-1 Objects and Motion
Page T-276/S-165 Relative Motion (20 min.)

PURPOSE: Increase the ability to describe motion by introducing the term relative to.

ADVANCE PREPARATION: Materials - none.

Language Cards/Key Sign
relative to
relative
motion
reference objects

TEACHING SUGGESTIONS:

1. Explain to the students that in this lesson they will learn how to use the term relative to to describe the relation of moving objects to reference objects.

2. Have the students read page 165 and answer the questions. Teacher may paraphrase.

3. Let the students share their responses with their neighbors as they work.

4. Discuss the lesson with the students when they have completed their work.

5. Help the students use the term relative to by following your example. Describe such motion as "the book is moving relative to the bookend" or describe lack of motion as "the book is not moving relative to my hand."

6. Encourage student use of the term. Have one student walk past another or move an object past another and describe the objects that are moving relative to other objects. Have the students name the moving object and the reference objects involved.

DESIRED LEARNING OUTCOME: Ability to use the term relative to in describing the relations of moving objects to reference objects.

****

DEVELOPMENT: Lesson Cluster 3A-1 Objects and Motion
Page T-278/S-166 Using Reference Objects (45 min.)

PURPOSE: Extend the concept of motion relative to one object to motion relative to more than one object.

ADVANCE PREPARATION: Materials - paper and pencil for each student

Language Cards/Key Signs
position
relative
reference objects

TEACHING SUGGESTIONS:

1. Have a student sit on a chair in front of the class. Slowly push the seated student and chair to the left and then back to the right.

2. Ask the class whether or not the student moved. Challenge the students to explain their answers. Make sure that they describe the motion in terms of reference objects and that they use the term relative to. For example, the student moved relative to the floor, to the student desks, and to the wall of the room. The student did not move relative to the chair because the student's position in the chair did not change.

3. Have the students turn to pages 166 and 167. Ask them to read the pages and record their answers to the questions on a separate piece of paper. Teacher may paraphrase.

4. Discuss the students' responses with them when they have completed their work.

5. Take time to have the students verbally describe the motion of the objects in the pictures. This will help them to develop their skills in observing and analyzing situations involving motion. In the discussion of the pictures on pages 166-167, you may find that a student insists that the moved objects remained stationary and everything else, including the walls of the room, moved. Accept this answer because it is one possible explanation. Students usually have difficulty in observing that the table moved relative to the wall. Help them by stressing the importance of reference objects.

DESIRED LEARNING OUTCOME: Ability to distinguish between objects that move and those that do not move and describe the motion of objects.

****

ENRICHMENT: Lesson Cluster 3A-1 Objects and Motion
Page T-277 What Moved? (25 min.)

PURPOSE: Provide further practice in identifying objects that move and describe their position relative to other objects.

ADVANCE PREPARATION: Materials - Each pair of students will need 1 set of 5 objects such as:
- scissors
- pencils
- rulers
- paper clips
- eraser

Teacher should copy the rules for the game on the board or transparency so students may refer to them.

TEACHING SUGGESTIONS:

1. Divide the class into pairs and distribute a set of objects to each pair.

2. Explain to the students that they are going to play a game in which they will identify an object that has been moved and describe its new position relative to other objects.

3. Read the rules of the game to the students. Copy them on the board for reference. You may wish to have two students demonstrate the game for the class as you read, using the set of objects that you have given to them.

   Rules

   a. Arrange a set of objects on a desk.
   b. Player 1 studies the position of each object relative to the other objects.
   c. Player 1 shuts his or her eyes while player 2 moves one object on the desk.
   d. Player 1 then opens his or her eyes. He or she must identify the object that was moved and describe its new position relative to the other objects.
   e. Player 2 carefully listens to make sure that player 1 is correct.
   f. Play the game several times. Take turns being player 1 and player 2.

4. Have the pairs of students play the game.

5. Circulate around the room observing the students as they play the game. If students show proficiency, you may suggest that two objects be moved instead of one.

DESIRED LEARNING OUTCOME: Identify an object that has moved and describe its position relative to other objects.

****

APPLICATION: Lesson Cluster 3A-1 Objects and Motion
Page T-280/S-168 What Is Moving? (30 min.)

PURPOSE: Introduce the concept that objects are in motion when their positions are changing.

ADVANCE PREPARATION: Materials - paper and pencil for each student

Language Cards/Key Signs
relative to
moved
reference object

TEACHING SUGGESTIONS:

1. Introduce the lesson by having a student walk back and forth in front of the class.

2. Challenge the class to describe the student's motion accurately in terms of various reference objects. Encourage the students to use the term relative to in describing the motion.

3. Walk back and forth in front of the class. While walking, ask the class, "Am I moving?" Then ask, "How can you tell?" Stress that objects are in motion when their positions are changing and that the only way to tell whether or not their positions are changing is in relation to reference objects.

4. Have the students turn to page 168 and read the introductory paragraph. Teacher may paraphrase.

5. Check the students' understanding with a brief discussion, referring them to the previous demonstration.

6. Have the students read the remainder of the page and record their responses to the questions.

7. Allow the students to discuss their responses with their neighbors as they work.

8. Discuss the students' responses with them when they have completed their work. The students should be able to explain that the girl and umbrella are moving relative to the fire hydrant and the tree. They should further explain that the sidewalk is not moving relative to the tree, nor is the umbrella moving relative to the girl.

9. Stress that simply saying that an object is moving is less useful than specifying motion relative to another object is. Also stress that objects are in motion when they are undergoing a change in position.

DESIRED LEARNING OUTCOME: Describe the motion of an object relative to various reference objects and explain that an object is moving if its position is changing relative to a reference object.

****

EVALUATION: Lesson Cluster 3A-1 Objects and Motion
Page T-280/S-169 Identify the Movers (30 min.)

PURPOSE: Evaluate students' performance in relation to the following objectives:

1. Identifying objects that have or have not moved.
2. Naming reference objects used to determine whether or not objects moved.
3. Stating whether or not an object moved relative to another object.
4. Explaining how they can tell if an object has moved.

ADVANCE PREPARATION: Materials - paper
pencil
text for each student

TEACHING SUGGESTIONS:

1. Have the students turn to page 169 and read through the lesson. Teacher may paraphrase.

2. Be certain the students understand what they are to do.

3. Have the students do the lesson.

4. Go over the students' responses with them when they have completed their work. If you wish, let the students correct their own papers to enable them to evaluate their own progress.

5. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 3 Motion

Part A Relative Motion, Lesson Cluster 3A-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-286	Introduction	Before and After	25 min.
T-288	Development	Blurred Pictures	20 min.
T-290	Development	Tracks and Objects	30 min.
T-291	Enrichment	Collect Some Tracts	60 min.
T-292	Development	Reading Tracks	30 min.
T-294	Application	Motion Detective	30 min.
T-295	Evaluation	What's the Evidence?	30 min.

NOTE: Collect Some Tracks is optional.

B. MATERIALS: Add the following to the Materials List on page T-283:
- 16 mm film (subject not important)

FILMSTRIP INFORMATION: Filmstrip Sets XII, Place and Motion and XV Relative Motion, are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3A-2 Records of Motion
Page T-286/S-170 Before and After (25 min.)

PURPOSE: Introduce the concept that photographs can show evidence of the motion of objects or of the camera.

ADVANCE PREPARATION: Materials - none.

Language Cards/Key Signs
evidence
photograph
motion

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing with the students how they can tell whether or not an object has moved. Help them to remember that the motion of an object can only be described relative to reference objects.

2. Explain to the students that when photographs are used to produce evidence of motion, the evidence sometimes shows that an object moved and sometimes that the camera moved.

3. Have the students read page 170 and answer the questions using the photographs on page 171.

4. Circulate around the room providing help as it is needed.

5. Have students who have difficulty in determining whether or not the camera moved make a cylinder from a piece of paper and view a single set of objects from at least two different angles. You might also have them look through the cylinder at the same object up close and then farther away. This can help them to understand what a camera "sees" from different positions.

6. Discuss responses to the questions and the photographs with the students when they have completed the lesson.

7. Emphasize that photographs can be used to determine evidence of motion.

8. Be sure the students understand that if an object changes position in "before" and "after" photographs, it is evidence that the object moved. If the size of the objects or the angle at which they are viewed relative to other objects in the photograph changes, it is evidence that the camera moved.

DESIRED LEARNING OUTCOME: Explain whether an object or the camera moved in terms of evidence in "before" and "after" photographs.

****

DEVELOPMENT: Lesson Cluster 3A-2 Records of Motion
Page T-288/S-172 Blurred Pictures (20 min.)

PURPOSE: Develop the concept that blurred photographs show evidence of motion.

ADVANCE PREPARATION: Materials
- scissors for each student
- paste
- several magazines (to be cut up) which have pictures showing motion
- paper, unlined, for mounting pictures
- cardboard or oaktag, 30 cm x 5 cm (12 in. x 12 in.)
- felt tip pen

Language Cards/Key Signs
blur
evidence
relative to

Identification Cards
Evidence of Motion (bulletin board heading)

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they are going to find more evidence of motion in photographs.

2. Have the students turn to page 172 and read the introduction to find out what can cause a blur in a photograph. Teacher may paraphrase.

3. Be sure the students understand that fast movement can blur a photograph and that the blur can be caused by fast movement of the subject or fast movement of the camera. Explain that a blurred photograph may result if the camera has not been focused.

4. Have the students turn to page 172. Tell them that the blur in the photograph on that page and in the ones on page 173 are the result of motion and not the result of a camera that has not been focused.

5. Have the students read page 172 and answer the italicized questions.

6. Discuss the photograph with the students when they have finished reading.

7. Have the students read page 173 and answer the italicized questions on that page when you are sure they understand how to interpret blurs in photographs.

8. Let the students discuss the photographs with their neighbors as they work.

9. Discuss the questions with the students when they have finished the page. Insist that they describe all motion relative to reference objects.

10. Ask the students if any of them have taken pictures of fast moving objects that resulted in blurred photographs. Have them share their experiences. Some students may be willing to bring in such pictures to share.

11. Discuss the project described in question 1 with the students. Show them where you have put the materials that they are to use. You may wish to have the students do the project as a free time activity.

12. Have the students pin up the photographs they find on the bulletin board. Ask one student to make a title for the display - Evidence of Motion.

13. Collect the magazines and save them for the students to use again in (3) Find the Axis in the next cluster.

DESIRED LEARNING OUTCOME: Identify blurred objects in photographs as evidence of motion.

****

DEVELOPMENT: Lesson Cluster 3A-2 Records and Motion
Page T-290/S-174 Tracks and Trails (30 min.)

PURPOSE: Review or introduce tracks and trails as evidence of motion.

ADVANCE PREPARATION: Materials - none.

Language Cards/Key Signs
tracks
trails
motion
records

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by challenging the students to think of some objects that leave a record of their motion. If the students have difficulty thinking of an example, draw a line across the chalkboard to help them get started.

2. Have the students read page 174 and answer the questions as they read. Teacher may paraphrase.

3. Let the students discuss their responses with their neighbors as they work.

4. Discuss the lesson with the students when they have completed their work. Insist that the students state their evidence in terms of the motion of an object relative to reference objects.

5. Extend the lesson by asking the students for examples of other objects that leave records of their motion. Some students may think of a power boat leaving a wave in water, a spider leaving a web, animals leaving tracks in snow, sand, or mud, or raindrops leaving a pattern on a windowpane.

DESIRED LEARNING OUTCOME: Infer motion from evidence in tracks and trails. Describe the motion relative to reference objects.

****

ENRICHMENT: Lesson Cluster 3A-2 Records of Motion
Page T-291 Collect Some Tracks - Optional (60 min.)

PURPOSE: Extend what has been learned about evidence of motion in photographs to the use of plaster molds to preserve evidence of animal motion.

ADVANCE PREPARATION:

Search the area around the school for animal tracks. Try to find a place where there are enough tracks for each group of three students to make a plaster mold of several small tracks that are evidence of animal motion or one large animal track. You may probably locate tracks made by dogs or cats.

Fill each group container with 150 mL (5 oz.) of water. The plaster can be added to each container and stirred just before the mixture is to be poured by the students outside. Take extra water in the milk jug to thin the plaster mixtures as the need arises.

Cut the cardboard strips. Collect the mixing spoons and paper clips and put them with the rest of the materials on the supply table. Obtain reference books showing pictures of animal tracks from the school or public library. If you assign the task to students, avoid having the entire class go to the library to get books on the particular topic when only a few books will probably be available at the elementary level. Clear a large table where the students may later display their track molds.

TEACHING SUGGESTIONS:

1. Introduce the lesson by having the students look once more at the pictures on page 174.

2. Explain to the students that tracks and trails similar to those pictured may not last very long. Discuss how long it might take for each track or trail to disappear and some possible causes for its disappearance. Emphasize that photographs of tracks and trails can be used to show evidence of motion long after the actual tracks and trails have disappeared.

3. Tell the students that they are going to use plaster molds to make another kind of record that preserves evidence of motion. They will make their records of tracks and trails near the school.

4. Divide the class into groups of three.

5. Distribute the cardboard strips and paper clips to each group.

6. Demonstrate how to bend a cardboard strip into a loop and fasten the ends together with a paper clip. Explain to them that they will use the loop as a frame to help form the sides of the mold. Further explain that they will put the frame around some small tracks or around a large track and then fill it with plaster to make a mold.

7. Distribute a container of water and a mixing spoon to each group. Explain to the students that they will mix the plaster outside so that the plaster does not harden before they are ready to pour it.

8. Assign students to carry the jug of extra water and the two boxes of plaster.

9. Take the class outside to the area where you have located tracks and let each group choose a place to work.

10. Suggest to the students that they carefully remove any stones, leaves, or other objects from the tracks.

11. Have one student from each group place the cardboard frame around several small tracks or one large one and then wiggle it until it is about .5 cm (1/6 in.) into the ground.

12. Begin to add plaster to the group containers. Add the plaster a little at a time while a student stirs. The mixture should look like thick cream when it is ready to pour. If necessary, add more water or plaster until the desired consistency is achieved.

13. Have two students in each group hold the frame while the third student pours the plaster.

14. Tell the students to etch their names or initials on the plaster before the plaster hardens. When the plaster has completely hardened, tell the students to lift up the cardboard frame with the mold in it and take it back to the classroom.

15. Let each group show its mold to the class and challenge students to try to identify the animal that made the tracks.

16. Have the students make a display of their track molds on a large table.

17. Extend the lesson, if you wish, by having the students look up their animal tracks and draw pictures of the animal that made them. Point out where you have put the reference books, crayons, and paper for them to use. Suggest that they write the name of the animal at the top of their pictures and put the pictures on the table beside their track molds. Some students may want to wrtie brief paragraphs about the animals to add to the display.

DESIRED LEARNING OUTCOME: Make molds of animal tracks and explain that track molds may be used to preserve evidence of motion.

****

DEVELOPMENT: Lesson Cluster 3A-2 Records of Motion
Page T-292/S-175 Reading Tracks (30 min.)

PURPOSE: Extend what has been learned about tracks as evidence of motion to the interpretation of tracks left by rolling marbles.

ADVANCE PREPARATION: Materials - Have the following for each pair of students:

- 2 pieces of white, unlined paper
- 1 marble, large, 2.5 cm (1 in.) in diameter
- 1 marble, small, 2 cm (3/4 in.) in diameter
- 1 piece of soft carbon paper
- 3 books
- 2 pencils

Collect the unlined paper and the soft carbon paper. The softer the carbon paper, the darker the marble tracks will be.

If you are unable to obtain marbles of the specified sizes, you can use steel spheres or other heavy spherical objects of similar sizes. Before using spheres other than marbles or steel balls in class, make sure that they will work. Place a white sheet of paper with a piece of carbon paper on top of it on the floor and roll the sphere across the carbon paper. If the sphere makes a track on the white paper dark enough for the students to see easily, the spheres may be used.

TEACHING SUGGESTIONS:

1. Introduce the lesson by waving a piece of chalk in a zigzag motion and ask the students to trace the motion of the chalk in the air with their fingers. Then, using a similar motion, make chalk marks on the chalkboard. Remind the students that some objects leave records of motion and other objects do not.

2. Roll a marble across a desk. Ask the students how they could make a record of the marble's motion. They may suggest putting chalk or water on the marble.

3. Have the students read column one on page 175 to find out another way to record the motion of a marble.

4. Demonstrate for the students how to cover the plain piece of paper with a sheet of carbon paper. Emphasize which side of the carbon paper is to be placed against the plain paper.

5. Discuss the directions with the students to make sure they understand what they are to do. Refer the students to the picture on page 175.

6. Divide the students into pairs and distribute the materials.

7. Tell the students to write "large" or "small" beside each track on the plain paper after they roll each marble. Remind them to take turns rolling the marbles and labeling the tracks.

8. Have the students complete the lesson.

9. Move from group to group to make sure the students are observing and comparing the tracks of the marbles after they are made and not simply rolling the marbles one after the other.

10. Give the groups clean sheets of plain paper after they have had sufficient time to practice making and interpreting marble tracks. Ask each group to make several sets of unlabeled marble tracks on the clean paper and then write the names of the group members at the top of the paper.

11. Collect the marbles and carbon paper.

12. Ask each group to exchange its track paper with a neighboring group to find out if the other group can tell the sizes of the marbles that made the tracks and the direction in which the marbles were rolled, and the speeds of the marbles.

13. Conclude the lesson by having the students tell how they determined relative sizes of marbles, relative speeds of marbles, and the direction in which the marbles were rolled from tracks.

DESIRED LEARNING OUTCOME: Record tracks of marbles on carbon paper and infer the relative sizes and speeds of the marbles and the direction in which the marbles were rolled from the tracks.

****

APPLICATION: Lesson Cluster 3A-2 Records of Motion
Page T-294/S-176 Motion Detective (30 min.)

PURPOSE: Apply evidence of motion to motion picture film and to multiple images on one photograph.

ADVANCE PREPARATION:

Background Information - Motion picture film consists of a strip of photographs called frames. A motion picture projector flashes individual frames in rapid succession on the screen. Silent projectors ordinarily flash 18 frames per second and sound projectors flash 24 frames per second. The objects on motion picture film change position only slightly from frame to frame. However, when the pictures are rapidly projected in the correct order on a screen, a viewer's eye and mind perceive motion.

Materials - paper for each student
- pencils for each student
- crayons for each student
- 16 mm film (topic is not important)

Language Cards/Key Signs

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to recall how photographs may be used to show evidence of motion. Explain that they will now find out about other ways in which cameras can record motion.

2. Have the students read page 176 and answer the questions. Teacher may paraphrase.

3. Use the 16mm film to illustrate the example in the text.

4. Discuss all the questions with the students when they have completed their work. Insist that they describe all motion relative to reference objects.

5. Help the students to understand when they are discussing question 1 that if the pictures were taken at a steady rate, the distances between the images in the picture would indicate whether the speed of motion changed or not.

6. Discuss the activity described in item 2 at the bottom of page 176. Make sure that the students understand what they are to do.

7. Distribute paper, pencils, and crayons and have the students draw and exchange pictures.

8. Extend the lesson, if you wish, to the operation of motion picture projectors. Have students who are interested in the science of motion pictures look up the topic at the school or public library and report to the other students during a later class.

DESIRED LEARNING OUTCOME: Identify evidence of motion on motion picture film and in a multiple-image photograph.

****

EVALUATION: Lesson Cluster 3A-2 Records of Motion
Page T-295/S-177 What's the Evidence? (30 min.)

PURPOSE: Evaluate the students' performance in relation to the following objectives:
1. Identifying objects or people that moved or did not move.
2. Stating whether or not a camera was moved when a photograph was taken.
3. Naming which object or person in a photograph moved faster.
4. Identifying which two sets of tracks in a photograph was made first and describing the evidence on which the identification was based.
5. Identifying the directions of motion in sets of tracks.

ADVANCE PREPARATION: Materials - paper, pencil and text for each student

TEACHING SUGGESTIONS:

1. Have the students turn to page 177 and read through the lesson.

2. Be certain that the students understand what they are to do.

3. Distribute the paper and pencils and have the students do the lesson.

4. Go over the students' responses with them when they have completed their work. If you wish, let the students correct their own papers to enable them to evaluate their own progress.

5. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 3 Motion

Part A Circular and Rotary Motion, Lesson Cluster 3A-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-300	Introduction	Circular Motion	15 min.
T-301	Development	Rotary Motion	20 min.
T-302	Development	Find the Axis	40 min.
T-304	Development	Clock and Counterclockwise	30 min.
T-305	Development	The Earth's Rotation	20 min.
T-306	Enrichment	The Traveling Moon	30 min.
T-307	Application	Night and Day	30 min.
T-308	Evaluation	Describing Circular and Rotary Motion	25 min.

NOTE: The Traveling Moon is optional.

B. MATERIALS: Materials list on page T-297.

FILMSTRIP INFORMATION: Filmstrip Set VII, Place and Motion and XV, Relative Motion are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3A-3 Circular and Rotary Motion
Page T-300/S-178 Circular Motion (15 min.)

PURPOSE: Introduce the concept of circular motion, which, like straight-line motion, must be described in relation to other objects.

ADVANCE PREPARATION: Materials - none.

Language Cards/Key Signs
circular motion
reference object
straight-line motion

TEACHING SUGGESTIONS:

1. Introduce the lesson by moving an object such as a chair or a desk in the room. Ask student to explain how they know that the object has moved. Insist that they explain the changed position of the object relative to a reference object.

2. Have the students read and answer the questions on page 178.

3. Let the students discuss the page with their neighbors as they work.

4. Circulate around the room making sure that the students are able to answer the questions.

5. Discuss the lesson with the students when they have completed their work.

6. Help the students to understand that they need a reference object to determine circular motion as well as straight-line motion. Emphasize that both kinds of motion can be described only in relation to reference objects.

DESIRED LEARNING OUTCOME: Identify circular motion and describe circular motion relative to reference objects.

****

DEVELOPMENT: Lesson Cluster 3A-3 Circular and Rotary Motion
Page T-301/S-179 Rotary Motion (20 min.)

PURPOSE: Introduce the concept of rotary motion around an axis.

ADVANCE PREPARATION: Materials - 1 wheel to demonstrate rotation around an axis

Language Cards/Key Signs
rotation
rotary motion
axis
axis of rotation
sphere

TEACHING SUGGESTIONS:

1. Have the students read the first parapgraph on page 179 to find out what the term rotation means.

2. Discuss the term rotation with the students, making sure they understand that rotation refers to the movement of a whole object. Use the wheel to demonstrate rotation.

3. Ask the students to read the rest of column 1. Discuss the picture of the bicycle and the meaning of the term axis with the students. While turning the wheel for demonstration, ask a student to identify the axis of rotation.

4. Have the students read the remainder of the page and answer the questions.

5. Discuss the questions with the students when they have completed their work. If students have difficulty with the concepts, extend the lesson by having the students rotate a variety of objects and identify their axes of rotation. For example, a student could hold the dully-sharpened end of a pencil in one hand and rotate the pencil with the other hand around an imaginary line through the pencil lead as an axis. Other students could stand up and slowly rotate themselves around an imaginary vertical axis.

DESIRED LEARNING OUTCOME: Identify rotating objects and their axes of rotation.

****

DEVELOPMENT: Lesson Cluster 3A-3 Circular and Rotary Motion
Page T-302/S-180 Find the Axis (40 min.)

PURPOSE: Provide further practice in identifying the axes of rotating objects.

Language Cards/Key Signs
axis of rotation
axis
rotate

ADVANCE PREPARATION: Materials - Have the following for each student:
- 1 pencil
- colored pencil or crayon
- 2 pieces of unlined paper
- scissors
- magazine
- colored paper for mounting pictures (optional)

Also have glue, a felt-tip pen, piece of oak tag, 30 cm x 5 cm (12 in. x 2 in.)

Look through the magazines you have saved from Blurred Pictures to make sure that there are some pictures in them of objects that rotate or that have parts that rotate. You may want to collect additional magazines, newspaper advertisements, or store catalogues. Put these materials with the scissors and paste on a supply table. If you plan to have the students mount their pictures, put the paper that they are to use with the other materials.

TEACHING SUGGESTIONS:

1. Review the term axis with the students making sure they understand that an axis is an imaginary line around which an object rotates.
2. Have the students read page 180.
3. Go over the directions for the lesson with the students, making sure that they understand what they are to do.
4. Distribute the materials and let the students begin working.
5. Circulate around the room providing help as needed.
6. Have the students discuss and compare the pictures.
7. Discuss the project described on page 181 with the students. Show the students where you have put the materials that they are to use.
8. Have the students pin up their pictures on the bulletin board. Ask one student to make a title for the display, Axis of Rotation.

DESIRED LEARNING OUTCOME: Draw the axes of rotation on pictures of objects.
****

DEVELOPMENT: Lesson Cluster 3A-3 Circular and Rotary Motion
Page T-304/S-182 Clockwise and Counterclockwise (30 min.)

PURPOSE: Extend the concept of rotation by introducing the terms clockwise and counterclockwise to describe direction of rotation.

Language Cards/Key Signs
clockwise
counterclockwise
rotate

ADVANCE PREPARATION: Materials - Have the following for each pair of students:
- 1 pencil
- 1 cardboard tube, such as from paper towels

TEACHING SUGGESTIONS:

1. Begin the lesson by holding the ends of an object and slowly rotating it in one direction.

2. Ask the students to describe the direction in which the object is turning. Students may suggest such descriptions as left, right, up, or down. If they do, identify two points on opposite sides of the object and ask the students to observe the points as you again turn the object. Students should find that their description will not work for both points at the same time. Help the students to understand that it is difficult to describe the direction of rotation of objects without using some special terms.

3. Have the students read the first column on page 182 to find out how to describe direction of rotation more easily. Teacher may paraphrase.

4. Discuss the terms clockwise and counterclockwise with the students when they have finished reading. Check the students' understanding of the terms by rotating an object and asking them to name the direction in which it is turning.

5. Have the students read the directions for the activity in the second column. Teaching may paraphrase.

6. Discuss the directions with the students making sure they understand what they are to do.

7. Divide the class into groups of two and distribute the materials.

8. Have the students do the activity.

9. Circulate around the room providing help as it is needed.

10. Discuss the numbered questions with the students when they have completed the activity. Make sure they understand that the terms clockwise and counterclockwise refer to the rotation of an object that is level and is approximately at a 90 angle to the viewer's line of sight.

DESIRED LEARNING OUTCOME: Use the terms clockwise and counterclockwise in describing directions of rotation.

****

DEVELOPMENT: Lesson Cluster 3A-3 Circular and Rotary Motion
Page T-305/S-183 The Earth's Rotation (20 min.)

PURPOSE: Extend the concept of rotation to the ,roation of the Earth.

ADVANCE PREPARATION: Materials - 1 globe.

Language Cards/Key Signs
sphere
axis
earth
rotation

TEACHING SUGGESTIONS:

1. Have the students read page 183. Teaching may paraphrase.

2. Use the globe to demonstrate the earth's rotation.

3. Let the students discuss the page with their neighbors as they work.

4. Discuss the italicized questions with the students. Suggest that they observe a bright star at different times during one evening. Obtaining such direct evidence from observation usually creates considerable interest. Provide time during class on the following day for the students to discuss their observations.

5. Have the class discuss the numbered questions. Have the students take turns spinning the globe and observing it first from the North Pole and then from the South Pole.

6. The Enrichment Lesson on page T-306 may be done following this lesson.

DESIRED LEARNING OUTCOME: Identify the direction of the Earth's rotation.

****

ENRICHMENT: Lesson Cluster 3A-3 Circular and Rotary Motion
Page T-306 The Traveling Moon - optional (30 min.)

PURPOSE: Determine from observation that the moon revolves around the Earth from West to East.

ADVANCE PREPARATION:

Background Information: The moon revolves around the Earth in a plane that is nearly the same as the plane of the Earth's path around the sun. As a result, people who live in northern temperate latitudes always see the path of the moon in the southern half of the sky. They see the sun there, too. Because of the rotation of the Earth from west to east, the moon, like the sun, appears to move from east to west across our sky.

Although you can see the sun and the other stars in nearly the same place in the sky at a certain time on Wednesday as it was on Monday, this is not true of the moon. Each day the moon appears a little farther to the left relative to the stars or other reference objects. That is, it appears a little farther to the east, since you are looking approximately to the south. From this observation, you can conclude that the moon is moving eastward around the Earth. The motion, like the rotation of the Earth, is counterclockwise, observed from the North Pole.

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that the moon travels around the Earth.

2. Tell the students that they are going to make some observations to find out which way the moon travels around the Earth.

3. Remind the students that because the Earth rotates, the stars appear to move in the sky. Because the Earth rotates once every 24 hours, they can look at a place in the sky two days in a row and see the same stars in that place.

4. Ask the students to observe the moon for three nights at home, at exactly the same time. Explain that they will determine the change in position of the moon relative to such reference objects as a building, a tree, or a pole. From these observations they will be able to tell in which direction the moon seems to be traveling relative to the Earth.

5. Emphasize with the students that they must use a reference object to observe the position of the moon each night. Explain that the closer the moon is to the reference object, the easier it will be for them to determine the moon's position. They should try to make their observations of the moon early in the evening near the time of the first crescent.

6. Ask the students to record the time and observe where they are standing the first time they observe the moon. On the second day and third days, they should observe the moon at the same time and from the same place as on the first day.

7. Tell the students that if clouds or bad weather prohibit their making observations on successive nights, they can use observations that are made several nights apart. You might use such observations as follows. Have the students describe the position of the moon observed, for instance, on Monday and Thursday. Then ask where the moon would have been seen on Tuesday and Wednesday if clouds had not hidden it.

8. Discuss the movement of the moon with the students when they have completed their observations. Students should have discovered on the second and third nights that the moon moved to the left or from west to east relative to their reference objects.

9. Draw a diagram of the Earth and the moon on the chalkboard. Ask a student to draw a curved arrow on the drawing of the Earth to show the direction in which the Earth rotates. Then ask another student to draw an arrow to show the direction in which the moon travels around the Earth. (See Figure 1)

10. Conclude the lesson by having the students describe the directions of the movement of the Earth and the moon.

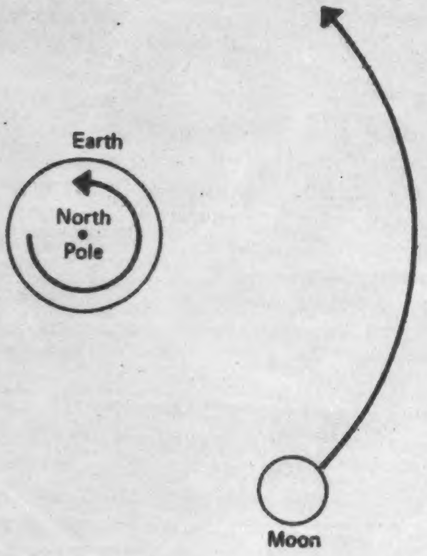

Figure 1. Earth and Moon.

DESIRED LEARNING OUTCOME: Determine from their own observations that the moon revolves around the Earth from west to east.

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APPLICATION: Lesson Cluster 3A-3 Circular and Rotary Motion
Page T-307/S-184 Night and Day (30 min.)

PURPOSE: Apply the concept of the Earth's rotation to the cause of night and day.

ADVANCE PREPARATION: Materials - pencil and unlined paper for each student
- 1 globe
- 1 flashlight

Language Cards/Key Signs
night
day
rotation

TEACHING SUGGESTIONS:

1. Using the globe and flashlight demonstrate night and day for the class. Illustrate how the earth's rotation causes day and night.

2. Have the students read the first paragraph on page 184. Teaching may paraphrase. Ask the students where the Earth's axis would be in the picture. (From the North Pole straight into the page.)

3. Have the students read the directions for the activity in the next paragraph.

4. Go over the directions with the students making sure they understand what they are to do.

5. Distribute the materials and have the students copy or trace the picture.

6. Tell the students that in drawing their pictures of the Earth, they do not have to make the shapes of the continents exact. It is important, however, that they accurately locate Denver and Guma as indicated by the cross and dot, respectively in the picture in their books.

7. Discuss the activity and the first numbered question when the students have completed their work. Ask a number of students to explain day and night in terms of the Earth's rotation to be certain that the students understand the concept.

8. Have small groups of students take turns using the flashlight and globe or have two students demonstrate night and day on the globe for the class. Put the flashlight and globe in a central location where students may work with them during their free time.

DESIRED LEARNING OUTCOME: Explain the occurrence of night and day in terms of the rotation of the Earth and the relative position of the sun.

****

EVALUATION: Lesson Cluster 3A-3 Circular and Rotary Motion
Page T-308/S-185 Describing Circular and Rotary Motion (25 min.)

PURPOSE: Evaluate students' performance in relation to the following objectives:
1. Identifying which objects moved in the pictures that show circular or rotary motion.
2. Determining whether a wheel is turning clockwise or counterclockwise.
3. Identifying the location of the Earth's axis of rotation.

ADVANCE PREPARATION: Materials - paper, pencils and text for each student

TEACHING SUGGESTIONS:

1. Have the students turn to pages 185 and 186 and read through the lesson. Teacher may paraphrase.

2. Be certain that the students understand what they are to do.

3. Distribute paper and pencils and have the students do the lesson.

4. Go over the students' responses with them when they have completed their work. If you wish, let the students correct their own papers to enable them to evaluate their own progress.

5. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

6. For further informal evaluation, have the students turn back to page 162 and look at the picture that introduces Part A. Ask them why they think that particular picture was used to introduce the part that they have just completed. Suggest that they look for clues in the part title and in the cluster titles on text pages 163, 170, and 178. The students should be able to:
infer that the people on the ferris wheel are moving along a circular path;
infer that the ferris wheel is rotating;
determine that the axis of rotation of the ferris wheel is through its center;
observe that no record of motion is left by the ferris wheel.

****

Part B Describing Position, Lesson Cluster 3B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-316	Introduction	Meet Owl	45 min.
T-318	Development	Name the Fruit	30 min.
T-319	Development	Find the Objects	30 min.
T-320	Development	Owl Describes Motion	30 min.
T-321	Development	Owl References Frames	30 min.
T-322	Application	A Treasure Hunt	30 min.
T-324	Evaluation	Using More Than One Owl	20 min.

B. MATERIALS: See Materials List on page T-313.

FILMSTRIP INFORMATION: Filmstrip Sets VII, Place and Motion and XV, Relative Motion are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3B-1 Reference Frames
Page T-316/S-188 Meet Owl (45 min.)

PURPOSE: Introduce the owl figure as an ideal observer and a reference object.

ADVANCE PREPARATION:

Background Information - The constant orientation for the Owl figures used throughout this cluster is as follows: The cross on Owl's chest is the starting point. Above is the area above the horizontal bar on the cross. Below is the area below the horizontal bar of the cross. Front is the face side of the Owl. Back is the nonface side of Owl. The lessons are clear in delineating the use of the terms close and far relative to Owl.

Materials - 1 large figure for demonstration front and back of Owl figure from appendices C & E, pages T-534-535
- glue, scissors, pencil, carboard 25 cm x 20 cm (10 in. x 8 in.)

Cut out front and back of large Owl. Trace it onto cardboard and cut out. Paste the front and back of figure on the cardboard backing.

Each child will need:
- 1 small owl figure, appendix B, page T-533
- 1 pencil
- unlined paper
- scissors
- variety of crayons or colored pencils

Language Cards/Key Signs
owl
reference
reference object
right
left
above
below
in front
in back
observer
close
far

Identification Cards

TEACHING SUGGESTIONS:

Be careful not to give human attributes to the Owl figure when referring to it. Set the example for the students by referring to the figure as "Owl" or "it". Avoid letting the students give their Owl figures gender identification. If you have the students color their Owl figures, do not let them draw clothes on them. Allowing students to conceptualize animals with human attributes can make it difficult for them in later studies of animal behavior.

1. Introduce Part B by having the students turn to page 187. Explain to the students that in this part they will learn some new ways to describe the positions of objects.

2. Begin the lesson by having the students read page 188. Teacher may paraphrase.

3. Discuss the orientations above, below, left, and right with the students, using the pictures in the book and the demonstration Owl. If children have difficulty, use an object in the room as a reference object and discuss orientation.

4. Have the students read the first paragraph on page 189 to find out how they are going to use the Owl figure.

5. Make sure the students understand that Owl's body is the only reference object that they will use in describing the positions of objects.

6. Hold up various objects in different positions around the demonstration Owl figure. Have the students describe the positions of the objects using the terms above, right, left, below, front and back relative to Owl. Then hold the Owl on its side and have the students describe how Owl would report the positions of the objects.

7. Ask the students to write their names on the Owl figures and to put them in their desks ready for use in the following lessons.

DESIRED LEARNING OUTCOME: Describe the position of an object in terms of front, back, right, above, below, close, and far relative to an Owl figure.

****

DEVELOPMENT: Lesson Cluster 3B-1 Reference Frames
Page T-318/S-190 Name the Fruit (30 min.)

PURPOSE: To provide practice in identifying objects whose positions are described relative to the Owl figure.

ADVANCE PREPARATION: Materials - 1 large Owl figure
- paper and pencil for each student

Language Cards/Key Signs
above
close
right
left
below
far

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing how an object is described relative to the demonstration Owl figure. Hold the Owl figure upside down relative to your body. Stress that the positions of objects must be described relative to Owl's body no matter what position it is in relative to other objects.

2. Have the students turn to page 190 and read through the lesson to find out what they are going to do. Teacher may paraphrase.

3. Discuss the directions with the students to make sure that they understand what they are to do.

4. Let the students do the lesson.

5. Discuss the lesson with the students when they have finished.

6. Help students who have had difficulty with the lesson by holding an object in various positions near the Owl demonstration figure. Ask them to describe the position of the object relative to Owl. You may want to assign the alternate lesson, Find the Object, to students who need further practice.

DESIRED LEARNING OUTCOME: Identify objects whose positions are described relative to the Owl figure.

****

DEVELOPMENT: Lesson Cluster 3B-1 Reference Frames
Page T-319/S-191 Find the Objects (30 min.)

PURPOSE: To provide practice in identifying objects whose positions are described relative to the Owl figure.

ADVANCE PREPARATION: Materials
- 1 large Owl figure
- small Owl for each child
- pencils
- objects from classroom*

*Each student will need four objects in this lesson. Begin the collection of objects with the pencils, scissors, and crayons that you gathered for other lessons. Supplement the collection with such objects as staplers, paper punches, rulers, paper clips, or books. The sets of objects may vary from student to student.

Language Cards/Key Signs
above
below
right
left
far
close

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing how an object is described relative to the demonstration Owl figure. Hold the Owl figure upside down relative to your body. Stress that the positions of objects must be described relative to Owl's body no matter what position it is in relative to other objects.

2. Have the students turn to page 191 and read through the lesson. Teacher may paraphrase.

3. Discuss the directions with the students to make sure that they understand what they are to do.

4. Have the students take out their Owl figures.

5. Distribute the objects that you have collected and have the students begin to work.

6. Circulate around the room providing help as it is needed.

7. Discuss the lesson with the students when they have finished.

8. Help students who have difficulty with the lesson by holding an object in various positions near the Owl demonstration figure. Ask them to describe the positions of the object relative to Owl.

DESIRED LEARNING OUTCOME: Identify objects whose positions are described relative to the Owl figure.

****

DEVELOPMENT: Lesson Cluster 3B-1 Reference Frames
Page T-320/S-192 Owl Describes Motion (30 min.)

PURPOSE: Extend the concept of relative motion by using Owl figures as reference objects to describe moving objects.

ADVANCE PREPARATION: Materials - 2 small owl figures
- paper and pencils

Language Cards/Key Signs
relative to
moving

Identification Cards

TEACHING SUGGESTIONS:

1. Place a small Owl figure in a prominent place in front of the room. Have a student walk slowly in front of the Owl. Ask the students how they would describe the motion relative to the Owl figure.

2. Have the same student carry a second Owl figure close to his or her body, and again walk in front of the first Owl. Ask the other students how the motion would be described relative to each Owl figure. The class should be able to see that the student is not moving relative to the second Owl, but all the other students and objects in the room are moving relative to it.

3. Have the students read the first paragraph on page 192. Teacher may paraphrase.

4. Ask the students to look at the picture on the page. Call their attention to the streakes in the picture that indicate the bicycle is moving. Explain that if this were a photograph, the bicycle would be blurred. For the purposes of the lesson, ask the students to treat the illustration as a blurred photograph.

5. Have the students read the italicized question and the directions in the second column.

6. Tell the students that they are going to have to study the picture carefully to answer the questions. Emphasize that motion in the picture has to be described differently relative to each Owl figure.

7. Have the students begin to work.

8. Discuss the lesson with the students when they have finished working. Some students may have difficulty describing motion relative to the Owl figure on the handle bar of the bicycle. Have these students walk in front of the class carrying an Owl

figure. This will enable them to observe that relative to the Owl figure they are carrying, the other students and objects in the room appear to be moving.

9. Conclude the lesson by emphasizing that motion is a continuous change in position and that the motion of an object as well as its position can be described only in relation to reference objects.

DESIRED LEARNING OUTCOME: Describe the motion of objects relative to three Owl figures.

****

DEVELOPMENT: Lesson Cluster 3B-1 Reference Frames
Page T-321/S-193 Owl Reference Frames (30 min.)

PURPOSE: Introduce the concept of reference frame using the Owl figure.

ADVANCE PREPARATION: Materials - 1 large Owl figure
- paper and pencils
- metric rulers

Language Cards/Key Signs
reference frame
starting point
starting direction
direction
distance

Identification Cards

TEACHING SUGGESTIONS:

1. Distribute metric rulers.

2. Introduce the lesson by briefly reviewing how to measure distance in centimeters (cm). Also review the symbol cm.

3. Explain to the students that they are going to learn to use reference frames to describe the position of objects more accurately.

4. Have the students read the first two paragraphs on page 193 to find out what a reference grame is. Teacher may paraphrase.

5. Discuss the term reference frame with the students using the demonstration Owl figure. Explain that they have estimated the distance of objects relative to a reference object in terms of close and far. They are now going to measure exact distance in cm.

6. Have the students take out their Owl figures and read the directions at the bottom of page 193.

7. Explain to the students that they are to use the same directions that they have been using before: above, below, left, right, front, and back. They are, however, to measure distance from the starting point to the object in cm.

8. Have the students begin to work.

9. Circulate around the room providing help as it is needed.

10. Discuss the lesson with the students when they have finished. Using the demonstration Owl figure, ask the students such questions as "How would you measure the distance from the Owl figure to the wall? Why is it necessary to use an exact starting point? How is direction determined using the Owl figure? What is a reference frame?" Because the students probably have a firm understanding of relative position at this time, try to center the discussion on the concept of a reference frame and its parts.

DESIRED LEARNING OUTCOME: Describe the position of objects in terms of direction and distance in reference frame such as the Owl figure.

****

APPLICATION: Lesson Cluster 3B-1 Reference Frames
Page T-322/S-194 A Treasure Hunt (30 min.)

PURPOSE: Apply the concept of a reference frame to clues in a treasure hunt.

ADVANCE PREPARATION: Materials - 1 large owl figure
- paper and pencils
- metric rulers

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing the concept of a reference frame. Use the demonstration Owl figure to indicate how to find the starting point, the starting direction, and the direction, and how to measure distances.

2. Tell the students that they are going to use their skill in using reference frames to solve a problem.

3. Have the students read the directions for the lesson on pages 194 and 195. Teacher may paraphrase.

4. Discuss the directions with the students. Delores should start with Owl C and George with Owl B. Emphasize that they should not tell their neighbors when they have found their answers. Stress that they should list the sequence of letters on a separate paper indicating the path of each treasure hunter. Before the students begin the lesson, you may wish to have them read the clues and predict which of the two hunters find the treasure.

5. Let the students begin to work.

6. Circulate around the room to make sure that the students understand the directions and can measure the distances.

7. Discuss the numbered question with the students when they have finished the activity. Have them describe how they reached their conclusions in terms of Owl reference frames.

8. Have students use the demonstration Owl figure to act out parts of the treasure hunt with which they have difficulty.

9. Extend the lesson, if you wish, by having some students set up treasure hunts with Owl figures for the rest of the class. This may be assigned as a free-time activity.

DESIRED LEARNING OUTCOME: Follow clues in a treasure hunt by using Owl figures as reference frames.

****

EVALUATION: Lesson Cluster 3B-1 Reference Frames
Page T-324/S-196 Using Moee Than One Owl (30 min.)

PURPOSE: Evaluate student's performance in relation to the following objectives:

1. Measuring distances between objects within a reference frame.
2. Describing the relative positions of objects within a reference frame.
3. Describing the relative motion of objects within a reference frame.

ADVANCE PREPARATION: Materials
- paper
- pencil
- textbook
- metric rulers

TEACHING SUGGESTIONS:

1. Have the students turn to page 196 and 197 and read throug the lesson.

2. Be certain that the students understand what they are to do.

3. Distribute the materials and have the students do the lesson.

4. Go over the students' responses with them when they have completed their work. If you wish, let the students correct their own papers to enable them to evaluate their own progress.

5. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 3 Motion

Part B Describing Position, Lesson Cluster 3B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-330	Introduction	Owl and Circles	30 min.
T-332	Development	A Helecopter View	30 min.
T-333	Development	Direction to Cities	30 min.
T-334	Development	A Reference Frame at Sea	30 min.
T-336	Application	Radar and Reference Frames	30 min.
T-338	Evaluation	Locating Positions	20 min.

NOTE: Radar and Reference Frames is optional.

B. MATERIALS: Add the following to the Materials List on page T-327:
- 1 large owl figure

FILMSTRIP INFORMATION: Filmstrip Sets VII, Place and Motion and XV, Relative Motion are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3B-2 Using Numbered Circles
Page T-330/S-198 Owl and Circles (30 min.)

PURPOSE: Introduce a numbered circle as a reference frame.

ADVANCE PREPARATION: Materials - paper, pencil and metric ruler for each student
- 1 large owl figure
- reproduction of the illustrations on page 198 and 199 on the blackbeard; tape the large owl on the board as the center of of each illustration.

Language Cards/Key Signs
numbered circles
reference frame
clock
clockwise
distance
degree
circle
starting point
starting direction
direction

Identification Cards

TEACHING SUGGESTIONS:

1. Review with the students the elements in a reference frame: a starting point, a starting direction, a direction and a distance.

2. Have the students turn to page 198.

3. Introduce the cluster by telling the students that they are going to learn to use numbered circles as reference frames.

4. Have the students read the introduction on page 198.

5. Use the clock system illustration on the board to clarify the text.

6. Have students complete reading page 198 and begin the first part of the lesson. It may help to do the first 2 items as a class. Using the board illustration.

7. Have the students compare their results when they have completed their work.

8. Be sure the students understand that the starting direction on a clock is twelve o'clock. It is understood that zero o'clock, which does not appear on a clock is actually the starting direction.

9. Discuss the italicized questions. Stress the inadequacy of using a clock face to determine direction. It is not precise enough for many purposes. Point out that it is difficult to tell just where the shoe is. Some students may give the direction to the shoe as 7:30, but even that is not as precise as possible.

10. Ask the students if they can think of a way to make a numbered circle more precise.

11. Use the degree system illustration on the board to introduce and explain page 199 of the text.

12. Have the students read page 199 and answer the italicized questions.

13. Discuss the page with the students when they have finished. Stress that the system most often used has 360 equal parts to a circle and that each part is called a degree.

14. Be sure that the students understand how to record positions relative to a circle in degrees. Remind them that the numbers on a clock increase clockwise and so do the degrees on a circle.

15. End by discussing the numbered questions at the end of the cluster.

DESIRED LEARNING OUTCOME: Describe the positions of objects relative to a numbered circle reference frame.

****

DEVELOPMENT: Lesson Cluster 3B-2 Using Numbered Circles
Page T-332/S-200 A Helicopter View (30 min.)

PURPOSE: Introduce the polar grid as a special kind of reference frame.

ADVANCE PREPARATION: Materials - paper, pencils and metric rulers for each student

Language Cards/Key Signs
polar grid
degrees

Identification Cards

Background Information - A polar grid is a standard reference frame used to determine the coordinates of a point. The pòlar grid consists of a set of concentric circles around the central point from which a set of lines radiates.

On a polar grid, direction is measured in degrees, starting at zero degrees, the starting direction. Distance is measured from the center of the circle, the starting point, to a second point. The two measurements of direction and distance are the coordinates of apoint or object.

This lesson and the next concentrate on determining direction with a polar grid. A third lesson, A Reference Frame at Sea, introduces the use of a polar grid in determining distances.

TEACHING SUGGESTIONS:

1. Begin the lesson by sketching a numbered circle on the chalkboard. Review with the students how to measure direction in degrees on a numbered-circle reference frame, beginning at the starting direction and reading the degrees clockwise. Demonstrate for the students how they can use the straight edge of a ruler to help them read degrees on a circle more precisely. Using the circle on the board, show how to line up the ruler with the starting point (the center of the circle) and an object.

2. Have the students turn to page 200 and read the first paragraph. Teacher may paraphrase.

3. Discuss the term polar grid with the students to make sure they understand how a polar grid differs from the other numbered circles used previously. Have students refer to the pictures on page 198, 199,and 200 to compare the clock system, degree system, and polar grid.

4. Have the students read the remainder of page 200 to find out how they are going to use a polar grid.

5. Discuss the directions with the students. Point out that each "landmark" on page 200 has a red dot on it.

6. Distribute the materials and have students begin.

7. Move among the students providing help as it is needed.

8. Discuss the lesson with the students when they have finished.

DESIRED LEARNING OUTCOME: Measure direction in degrees on a polar grid.
****

DEVELOPMENT: Lesson Cluster 3B-2 Using Numbered Circles
Page T-333/S-201 Direction to Cities (30 min.)

PURPOSE: Provide additional practice in measuring direction in degrees on a polar grid.

ADVANCE PREPARATION: Materials - paper, pencil and metric rulers

Language Cards/Key Signs
polar grid

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson with a brief review of how to measure direction in degrees on a polar grid.

2. Have the students read page 201. Teacher may paraphrase.

3. Go over the directions with the students.

4. Review or introduce the process of estimating. By fifth level, most of the students will probably have had some experience, in math classes, in estimating by rounding off numbers and in estimating measurements on rulers to the nearest cm. However, be sure at this time that the students can estimate measurements to the nearest ten degrees. Explain to the students that they can measure a direction on a polar grid that falls between the marked off lines by first observing whether the measurement fall half way or more between the two lines or less than half way between the two lines. If they judge that the measurement falls half way or more than half between lines, the measurement is read on the degree line that follows. If the measurement falls less than half way between the lines, the measurement is read on the previous degree line.

5. Let the students begin to work.

6. Go over the students' responses with them.

7. Discuss the numbered questions with the students. Ask them how they listed the direction of a city when the degree measurement did not fall exactly on one of the marked parts of the polar grid. In the discussion of question 2, most students will probably say that 360 parts to a circle are not always enough for giving directions. Ask the students if they can think of a way in which they could make a more accurate guess, or estimation, of measurement on a numbered circle other than to the nearest ten degrees. Some students may think of dividing each degree into ten parts and then reading the measurement to the nearest degree.

8. Have the students again find the directions to the cities on the map on page 201, this time estimating the measurements to the nearest degree. (Optional)

DESIRED LEARNING OUTCOME: Measure direction in degree on a polar grid.
****

DEVELOPMENT: Lesson Cluster 3B-2 Using Numbered Circles
Page T-334/S-202 A Reference Frame at Sea (30 min.)

PURPOSE: Extend the concept of a polar grid to the description of coordinates on a polar grid used as a reference grame.

ADVANCE PREPARATION: Materials - paper, pencil and metric rulers

Language Cards/Key Signs
polar grid
reference frame
distance
direction
coordinates

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by briefly reviewing the elements of a reference frame: a starting point, a starting direction, a direction and a distance.

2. Have the students read page 202 as far as the numbered activity. Teacher may paraphrase.

3. Have the students read the directions for the numbered activity at the end of the lesson.

4. Go over the directions with the students to make sure they understand what they are to do. Make a chart with three columns on the chalkboard to show the students how to record coordinates. Number from 1 through 10 in the first column. Write degrees at the top of the second column and cm at the top of the third column. Write the directions to the boat in the picture onpage 202 in the second column, and its distance in the third column.

5. Distribute the materials and have the students begin to work.

6. Circulate among the students making sure that they are recording coordinates in the proper onder: direction, then distance.

7. Have the students compare and discuss their lists of coordinates when they have completed their work. Emphasize that numbers that locate a point in space are called coordinates.

8. Stress that coordinates are very useful in mathematics and in science. They are used to describe the positions of ships at sea, aircraft in the air, rockets in space, and other objects that are away from fixed landmarks.

DESIRED LEARNING OUTCOME: Describe the coordinates of a point on a polar grid used as a reference frame.

****

APPLICATION: Lesson Cluster 3B-2 Using Numbered Circles
Page T-336/S-203 Radar and Reference Frames Optional (30 min.)

PURPOSE: Apply what has been learned about polar grids to the use of polar grids in radar systems.

ADVANCE PREPARATION:

Language Cards/Key Signs
radar
reference frames

Identification Cards

Background Information - Radar uses echos to locate objects. The radar transmitter sends out pulses of energy, receives them back when they are reflected, and then interprets what it has received into a form that the operator can use. Basically the apparatus gives the operator three vital pieces of information: range, direction, and altitude. The range is determined by timing the interval it takes for the signal to travel from the antenna, be réflected, and return. Because the speed of the signal is known, the distance can be calculated. The direction of the plane is the same as the direction the signal takes to the aircraft. The altitude can, and is, determined in two separate ways: A device on the aircraft, called a radar altimeter determines height and transmits it to the radar on the ground. The second method is that the ground radar can determine the angle at which the signal is being returned. This angle plus the distance to the aircraft can be converted mathematically into the altitude of the plane.

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students if any of them know how an airplane is able to land at an airport in fog or rain, or, how the people in a control tower at an airport keep track of the planes that land and take off. Most of the students will probably know that radar is somehow involved, but they will probably not know how radar works.

2. Explain to the students that, in the lesson they are about to do, they will learn how radar works and how polar grids are used in radar systems.

3. Have the students read pages 203 and 204 and answer the questions.

4. Discuss the pages with the students when they have finished reading and have had an opportunity to think about the questions.

5. Stress that radar systems are used to determine the exact position of objects that are far from landmarks.

6. Explain to the students that a controller in the tower at an airport is able to determine the coordinates of the dot representing an airplane by using a polar grid. Further explain that the motion and speed of the plane is determined by locating the airplane at regular time intervals.

7. Extend the lesson by assigning special reports about radar and radar detection to interested students. Suggest that they ask a librarian in the school or public library to help them find magazines and books with simple explanations of radar systems.

8. Suggest to the students that they watch the weather report on the local television station if the forecaster uses a polar grid on a radar screen to describe the location of particular storm centers.

DESIRED LEARNING OUTCOME: Describe how polar grids are used in radar and how observing the position of a moving object at regular intervals enables one to determine its speed and direction.

****

EVALUATION: Lesson Cluster 3B-2 Using Numbered Circles
Page T-338/S-205 Locating Positions (20 min.)

PURPOSE: Evaluate the students' performance in relation to the following objective: describing the position of objects using the coordinates on a polar grid as a reference.

ADVANCE PREPARATION: Materials - paper, pencils, metric rulers and textbooks

TEACHING SUGGESTIONS:

1. Have the students turn to page 205 and read through the lesson. Teacher may paraphrase.

2. Be certain that the students understand what they are to do.

3. Distribute the materials and have the students do the lesson.

4. Go over the students' responses with them when they have completed their work. If you wish, let the students correct their own papers to enable them to evaluate their own progress.

5. Collect the papers so you can evaluate each individual's progress. If a student has recorded all or most of the coordinates correctly, you may assume that he or she has demonstrated the objective for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 3 Motion

Part B Describing Motion, Lesson Cluster 3B-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-344	Introduction	Map Reading	45 min.
T-346	Development	Map of a School	45 min.
T-350	Enrichment	Map of the Classroom	45 min.
T-347	Development	In An Old Western Town	30 min.
T-348	Development	Identify the Position	45 min.
T-350	Enrichment	Grid Game	30 min.
T-351	Application	Flip Books and Grids	35 min.
T-352	Evaluation	Describing With Numbered Lines	30 min.

B. MATERIALS: Add the following to the Materials List on page T-341:
- a large piece of white paper
- a copy of a map using letters and numbers for location for use on board or transparency
- (optional) a copy of a simple map using letters and numbers for location for each student

FILMSTRIP INFORMATION: Filmstrip Sets VII, Place and Motion and XV, Relative Motion are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3B-3 Using Numbered Lines
Page T-344/S-206 Map Reading (45 min.)

PURPOSE: Introduce a system of letters and numbers that is used to describe locations on maps.

ADVANCE PREPARATION:

Background information - A rectangular grid consists of two numbered lines at right angles to each other. The starting point is at the intersection of the two numbered lines. To describe the position of an object, distances are measured from the starting point along each numbered line. These two distances are called rectangular coordinates. It is customary to write the horizontal distances first and then vertical distance. The two numbers are separated by a comma and enclosed in parentheses (x,y).

Materials - Have the following for each pair of students:
- paper and pencil
- map of state for each pair of students

Language Cards/Key Signs
numbered lines
map
landmark

Identification Cards

Also have:
- simple sketch of a map using letters and numbers of location; put this on the board or transparency
- ditto copy of a simple map for each student if additional practice is necessary

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students read the first two paragraphs on page 206.

2. Discuss the paragraphs with the students when they have finished reading. Ask the students to relate experiences that they and their families may have had in using a map to find their way to a landmark in an unfamiliar city.

3. Before the students continue reading, explain how to use the numbers and letters on a map to find a location. Use the sample you have made as an illustration. Have the students name the letter-number locations for each item on the map.

4. If more practice is needed have the students complete a ditto of another simple map.

5. Have the students read the next three paragraphs. Teacher may paraphrase.

6. Make sure the students understand that they start at the lower left-hand corner of the map, move to the right until they come to the desired letter, and then move up until they come to the correct number.

7. Have the students read the directions for the activity. When they understand what they are to do they should begin.

8. Have the students compare and discuss their lists when they have completed their work. You may wish to copy the incomplete list on page 207 on the chalkboard and then have students take turns going to the board to fill in the blanks.

9. Divide the students into groups of 2 and distribute the maps that you have collected.

10. Ask the students to read the directions to the numbered activity at the end of the lesson on page 206. Explain to them that one member of each group is to name a city or town listed on the map and the others in the group are to take turns naming and locating cities and towns. As an alternative the teacher may list several cities on the board for the students to locate.

DESIRED LEARNING OUTCOME: Locate cities or towns on a map using letters and numbers to describe their positions.

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DEVELOPMENT: Lesson Cluster 3B-3 Using Numbered Lines
Page T-346/S-208 Map of a School (45 min.)

PURPOSE: Provide additional practice in using letters and numbers to describe locations on a map.

ADVANCE PREPARATION: Have the following for each student:
- pencil
- copy of a map of school from Appendix E, page T-536

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TEACHING SUGGESTIONS:

Language Cards/Key Signs
map
landmark

Identification Cards

1. Introduce the lesson by explaining to the students that in this lesson they will pracrice using the letters and numbers on a map to locate objects.

2. Have the students read page 208. Teacher may paraphrase.

3. Go over the directions for the activity with the students, and explain that they are to write the letter and then the number of each location.

4. Distribute the maps and pencils and let the students begin to work. If necessary find the location of the fire station as a class.

5. Circulate among the students providing help as it is needed.

6. Have the students compare and discuss their lists when they have completed them. You may wish to copy the list of landmarks on page 208 on the chalkboard and then have students take turns going to the board to fill in the locations.

7. Discuss the numbered questions with the students as a review.

8. See page T-350 for the Enrichment (A) that follows this lesson.

DESIRED LEARNING OUTCOME: Locate landmarks on a map using letters and numbers to describe their positions.

****

ENRICHMENT: Lesson Cluster 3B-3 Using Numbered Lines
Page T-350 Map of the Classroom (45 min.)

PURPOSE: Provide further practice in using letters and numbers to describe the locations of objects on a map.

ADVANCE PREPARATION: Materials - paper and pencils
- crayons, colored pencils
- a very large piece of white paper (see number 13 below)

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they are going to draw maps of the classroom using a system of letters and numbers.

2. Review, if necessary, the number and letter system used on maps.

3. Explain to the students that they may use as many letters and numbers on their maps as they wish, but they must start with the Letter A and the numeral 0. Ask them to leave a space on one side of their papers where they will later make a list of "landmarks" shown on their maps.

4. Distribute the materials and have the students begin.

5. Discuss with the students the maps that they have made and any difficulties that they may have encountered while making them.

6. Have the students list on their maps of the classroom, landmarks shown and the letters and numbers that tell their locations. However, ask them to leave either the name of the landmark of its location blank on each line of the list.

7. Have the students exchange maps with their neighbors.

8. Explain to the students that they are to fill in the blanks on the map they have received. Caution them to write neatly in pencil and only in the blank spaces.

9. Ask the students to return the maps to their owners when they have finished filling in the blanks. The owners should then check the lists to make sure that the blanks have been correctly filled in.

10. Ask the students if a location given for a specific object on their list would necessarily match the location of the same object on another student's list. Have one student name an object on his or her map and describe its location to the rest of the class. Then have several other students who have the same object on their maps tell how the object was described.

11. Ask the students why the locations of objects may differ from map to map. They may give such reasons as the objects are lettered or numbered differently, the distances between the letters or between the numbers varied, the arrangement of the drawn objects may differ relative to each other, and the shape and size of the maps may vary.

12. Tell the students that it is all right if the locations of objects varied from map to map. It is important only that objects on each particular map are located relative to each other.

13. A variation on this lesson would be to make one large map as a class. This map would be designed in the same way as the individual maps. It could be used as a bulletin board display when finished.

DESIRED LEARNING OUTCOME: Draw a simple map of the classroom using letters and numbers to describe the locations of objects shown.

****

DEVELOPMENT: Lesson Cluster 3B-3 Using Numbered Lines
Page T-347/S-209 In An Old Western Town (30 min.)

PURPOSE: Introduce the concept of rectangular coordinates.

ADVANCE PREPARATION:

Background Information - Until now, the students used an informal system of recording coordinates in charts. In this lesson, and in the rest of the lessons in the cluster, they will use a transitional system that differs from formal notation (x,y) only in that the parentheses around the coordinates are omitted.

Language Cards/Key Signs
map
directions
pattern

Identification Cards

Materials - textbooks

TEACHING SUGGESTIONS:

1. Have the students read through the lesson on page 209 to find out what they are going to do. Teacher may paraphrase.

2. Refer the students to the way that the pairs of coordinates are written. Explain to the class that in this lesson coordinates are written with a comma between them rather than in columns in a chart. Do not discuss which coordinate is written first at this time because the order of the coordinates is the pattern that they are to discover in the lesson.

3. Review or introduce the concept of pattern with the class. Students who have done the fourth level Patterns will probably remember that patterns are formed when objects are placed in orderly positions relative to each other.

4. Have the students begin to work.

5. Circulate around the room providing help as needed. Caution the students to look for the pattern in the old-timer's directions, not in the listed coordinates.

6. Have the students describe the pattern they found in the directions in their own words. Accept such descriptions as, "Across, then up."

DESIRED LEARNING OUTCOME: Infer a directional pattern that explains the pairings of coordinates applied to a map grid.

* * *

DEVELOPMENT: Lesson Cluster 3B-3 Using Numbered Lines
Page T-348/S-210 Identify the Position (45 min.)

PURPOSE: Introduce the use of coordinates to describe the position of a point on a rectangular grid reference frame.

ADVANCE PREPARATION: Materials - paper and pencils

Language Cards/Key Signs
coordinates
reference frame
polar grid
left
right
across
rectangular
grid

Identification Cards

TEACHING SUGGESTIONS:

1. Ask the students to look at the picture on page 210. Be sure they understand that the evenly spaced horizontal and vertical lines form the grid. Ask the students why they think grids that look like this one are called rectangular grids and why pairs of numbers used to locate points on it are called rectangular coordinates. If necessary, review the properties of rectangles with the students.

2. Be sure the students understand how to use a rectangular grid. Draw a rectangular grid or copy the one on page 210 on the chalkboard. Then draw such shapes as a circle, triangle, and star at different places on the grid where the lines intersect. List the pairs of coordinates beside the grid that describe the position of each shape. Point to each pair of coordinates and ask the students to name the object whose position is described by the particular pair. Emphasize the "across, then up" directions in using rectangular coordinates to locate a position.

3. Have the students read the first three paragraphs on page 210. Teacher may paraphrase.

4. Have the students read the directions at the bottom of page 210. Teacher may paraphrase.

5. Distribute the paper and pencils. Ask the students to fold the paper in half lengthwise and write their answers on the left side of the fold. Explain that they will use the other half later.

6. If the students are unfamiliar with the animals' names, it will help to copy the grid on the board and write the name of each animal where its picture appears. This can be used for reference.

7. Have the students compare and discuss their answers when they have finished working.

8. Use the same technique as in number 6 if necessary.

9. Have the students continue with the lesson on page 211 as far as the numbered questions. Ask them to write their answers on the right side of their papers.

10. Circulate among the students providing help as it is needed.

11. Have the students discuss and compare their answers when they have completed their work.

12. Divide the class into pairs.

13. Have the students read activity 1 at the bottom of page 211.

14. Go over the directions for the activity with the students.

15. Ask them to use the back of their papers for drawing and writing.

16. Have the students begin to work.

17. Circulate among the students providing help as it is needed. Make sure the students correctly number their grids starting with 0 in the bottom left-hand corner.

18. This may also be done as a class activity, drawing one grid with pictures and then listing each pair of coordinates.

19. Discuss question 2 with the students. You may wish to draw a rectangular grid and a polar grid on the chalkboard to aid the students in the comparison.

DESIRED LEARNING OUTCOME: Locate objects on a rectangular grid using coordinates to describe their positions.

****

ENRICHMENT: Lesson Cluster 3B-3 Using Numbered Lines
Page T-350 Grid Game (30 min.)

PURPOSE: Provide additional practice in using coordinates to describe the positions of objects on a rectangular grid reference frame.

ADVANCE PREPARATION: Materials - none.

TEACHING SUGGESTIONS:

1. Draw a grid on the chalkboard. Number the grid from zero to five both horizontally and vertically.

2. Introduce the lesson by explaining to the students that they will be able to play a game using rectangular grids and coordinates.

3. Divide the class into two teams. One team will be called the "X's" and the other "O's."

4. Explain that the teams are to take turns describing locations on the grid with pair of coordinates. Each time a pair of coordinates is described, either an "X" or an "O" will be put on the grid by a member of the appropriate team. Each team is to try to be the first to describe five points in a row horizontally, vertically, or diagonally.

5. Have volunteers record the "X's" and "O's" on the grid as their positions are described by the teams.

6. Let the students begin to play.

DESIRED LEARNING OUTCOME: Locate points on a rectangular grid using coordinates to describe their positions.

* * *

APPLICATION: Lesson Cluster 3B-3 Using Numbered Lines
Page T-351/S-212 Flip Books and Grids

PURPOSE: Relate motion to change in position of objects.

ADVANCE PREPARATION: Materials - pencils
- several staplers
- 1 scissors
- 2 pieces of grid paper
23 cm x 30.5 cm
(9 in. x 12 in.)

Cut the sheets of grid paper into quarters with scissors or a paper cutter. It is important that the quarters be of equal size. Stack each eight pieces of grid paper separately, to be sure that the sheets in each stack are exactly the same size. Each student will need eight one-quarter pieces of grid paper.

Language Cards/Key Signs
position
motion
grid paper
flip book
sphere

Identification Cards

TEACHING SUGGESTIONS:

1. Have the students read page 212 as far as the numbered questions and study the pictures. Teacher may paraphrase.

2. Go over the directions with the students making sure they understand what they are to do. Students who have done the fourth level unit Patterns will probably remember making flip books to show patterns of motion.

3. Tell the students to draw colored-in circles to represent spheres on their flip-book pages. Suggest to them that after they number their grid sheets they think of the path along which they want their spheres to appear to move.

4. Explain to the students that they should draw spheres in exact positions on the intersecting lines on the grids. They should show the same amount of change in the sphere's position from grid to grid.

5. Distribute eight small grid papers to each student.

6. Have the students write their names on the back of the flip books.

7. Let the students read their flip books.

8. Have the students draw a second series of spheres on their flip book pages as described at the bottom of page 212. The students will probably have little difficulty in showing a second sphere moving faster or slower than they had on drawing the first sequence.

9. Let the students again share their flip books with their neighbors.

10. Have the students discuss question 2. Ask the students to describe motion. Be sure they understand that motion is a continuous change in position and that change in position is evidence of motion.

DESIRED LEARNING OUTCOME: Describe motion in terms of the change in position of an object on a grid.

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EVALUATION: Lesson Cluster 3B-3 Using Numbered Lines
Page T-352/S-213 Describing With Numbered Lines (30 min.)

PURPOSE: Evaluate the students' performance in relation to the following objectives:

1. Identifying objects that are located on a rectangular grid using coordinates to describe their positions.
2. Listing coordinates that describe the position of objects located on a rectangular grid.

ADVANCE PREPARATION: Materials - paper, pencils and textbooks

TEACHING SUGGESTIONS:

1. Have the students turn to page 213 and read through the lesson. Teacher may paraphrase.

2. Be certain they understand what they are to do.

3. Distribute the pencils and paper and have the students do the lesson.

4. Go over the students' responses with them when they have completed their work. If you wish, let the students correct their own papers to enable them to evaluate their own progress.

5. Collect the papers so you can evaluate each individual's progress. If a student correctly makes most of the responses, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

6. For further informal evaluation, have the students turn back to page 187 and look at the picture that introduces Part B. Ask them why they think that particular picture was used to introduce the part that they have just completed. Suggest that they look for clues in the part title and in the cluster titles on pages 188, 198, and 206. The students should be able to:
   a. Infer that the boy in the foreground is describing the direction in which the group should go relative to their position using a compass as a reference frame.
   b. Infer that the girl and the boy behind her are locating a city or landmark on the map using the letter and number system that describes its position.

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Level 5 Unit 3 Motion

Part C Changing Directions, Lesson Cluster 3C-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-358	Introduction	Who Has Seen the Wind?	20 min.
T-360	Development	Model A Pinwheel	50 min.
T-362	Development	Model B Pinwheel	50 min.
T-364	Development	String Power	30 min.
T-363	Enrichment	Box Kites	50 min.
T-366	Application	Airplanes	50 min.
T-368	Evaluation	Which Way Will It Move?	25 min.

NOTE: Box Kites is optional.

B. MATERIALS: See the Materials List on page T-355.

FILMSTRIP INFORMATION: Filmstrip Sets VII, Place and Motion and XV, Relative Motion are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3C-1 Moving Air and Flying Objects
Page T-358/S-215 Who Has Seen the Wind? (20 min.)

PURPOSE: Introduce or review the concept of balanced and unbalanced forces and relate it to motion.

ADVANCE PREPARATION:

Background Information - Force and motion are closely related. Balanced forces on an object do not cause the object to move or to change its motion. An unbalanced force can cause motion or a change in motion. The direction of the motion may not be in the same direction as the force exerted. Motion or foce in one direction may produce motion in another direction.

Materials - textbooks

TEACHING SUGGESTIONS:

1. Ask the students to describe evidence of the wind blowing that they have observed. Students might describe their hair and clothes moving, grass and other plants rippling, papers flying, or water from sprinklers changing direction.
2. Have the students read page 215 and answer the questions. Teacher may paraphrase.
3. Introduce or review the concept of force. Be sure the students understand the difference between a balanced and an unbalanced force. Emphasize that an unbalanced force causes motion or a change in motion.

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4. Discuss the italicized question with the students. Stress that there is sufficient evidence in the picture on page 215 to infer that the wind is exerting a force on the clothing even if the wind cannot be seen.

5. Emphasize in the discussion of question 1 that the wind is blowing across the land but the clothes are moving upward. Ask the students in what direction the clothes would blow if they were not attached to the clothesline.

6. Stress that motion or a change in the motion of an object is evidence of an unbalanced force acting on the object. You may want to have all or some of the students review balanced and unbalanced forces on page 86 and 87 of the unit FORCES.

DESIRED LEARNING OUTCOME: Infer that a change in the motion of an object is evidence of an unbalanced force acring on the object.

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DEVELOPMENT: Lesson Cluster 3C-1 Moving Air and Flying Objects
Page T-360/S-216 Model A Pinwheel (50 min.)

PURPOSE: Introduce the concept that motion in one direction can produce motion in another direction.

ADVANCE PREPARATION:

Background Information - When air strikes a slanted surface, part of the force is directed along the surface. However, part of the force is deflected perpendicular to the surface because slanted surfaces exert force on air and change its direction. Changes in the directions of force and motion may be determined by observing the direction in which a surface slants relative to the direction of air. In the cluster, the students observe the effects of the force of air on the motion of pinwheels, kites, and airplanes, enabling them to determine that motion in one direction can cause motion in another direction.

Materials - Have the following for each student or pair of students:
- Model A pinwheel from Appendix F, page T-537
- red crayon
- straight pin, long, with head such as hat or corsage pin
- eraser
- scissors
- paper, lined
- blue crayon
- glue or paste

Language Cards/Key Signs
motion
direction
pinwheel
prediction
clockwise
counterclockwise

Identification Cards

Decide whether you want each student or pairs of students to make one pinwheel. If the students work in pairs, one student can hold the parts of the pinwheel together while the other glues them. Duplicate enough copies of the pattern for the Model A pinwheel so that each student or pair of students will have one.

You may wish to have a few students construct pinwheels in advance of class so that you can observe difficulties that the students encounter in following directions or in constructing pinwheels. During the lesson those students could help others. If you prefer to have all students make pinwheels at the same time, you may wish to make a demonstration pinwheel and predict difficulties that the class may have.

Be sure that each student or pair of students has an eraser. When the pins are not being used, they should be stuck into the erasers as a safety precaution.

TEACHING SUGGESTIONS:

1. Introduce the lesson by showing the students a pinwheel that has been made. Explain that they are going to construct pinwheels like it.

2. Have the students read the directions and study the pictures on page 216. Teacher may paraphrase.

3. Discuss the steps in making a pinwheel with the students. Stress that the blades should be cured as in the pictures, not folded in toward the center.

4. Discuss the safety procedure for handling the pins. Tell the students that you will give them erasers before passing out the pins. You will then stick a pin in each eraser. The pin is to remain in the eraser until they are ready to use it. Caution them to handle the pins carefully because the points are sharp and could hurt them.

5. Divide the students into pairs if you have not planned to have each student make a pinwheel.

6. Distribute the materials and have the students begin to write their names on the pinwheel patterns before they cut them out.

7. Circulate among the students providing help as it is needed.

8. The teacher may choose to make a pinwheel during class in order to demonstrate the procedure.

9. Have each student or pair of students continue on to page 217 when they have finished making their pinwheels.

10. Have the students write down their predictions and then test them.

11. Have the students discuss and compare the accuracy of their predictions. Ask them on what they based their predictions. Most students probably predicted that the pinwheel would turn clockwise in the direction of the slant of the pinwheel blades.

12. Help the students to understand why the pinwheel turned counterclockwise in terms of forces. Have them observe the direction of the curve of the blades on which they blew. Explain that part of the force (air) directed to the blades "pushed" along the surfaces of the blades. However, remind the students that the blades "pushed back." Because the blades are curved, they directed part of the force sideways. Motion in one direction caused motion in the different direction - the pinwheel moved counterclockwise instead of clockwise.

13. Have all the materials except for the red crayons placed where they will be ready for use in thenext lesson. Collect and store the pinwheels for use in lesson (4) String Power.

DESIRED LEARNING OUTCOME: Demonstrate with a pinwheel that motion in one direction can produce motion in another direction.

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DEVELOPMENT: Lesson Cluster 3C-1 Moving Air and Flying Objects
Page T-362/S-218 Model B Pinwheel (50 min.)

PURPOSE: Provide practice in observing that motion in one direction can produce motion in another direction.

ADVANCE PREPARATION: Materials - Have enough of the following for each student or pair of students:
- straight pin
- eraser
- glue or paste
- scissors
- lined paper
- pencil
- blue crayon
- model B pinwheel from Appendix G, page T-537

Language Cards/Key Signs
pinwheel
prediction
clockwise
counterclockwise

Identification Cards

Duplicate enough copies of the pattern for the Model B pinwheel so that each student or pair of students will have a copy. If the students worked in pairs in the previous lesson, have them again work in pairs.

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they are going to make a Model B pinwheel and test it in the same way that they tested the Model A pinwheel.
2. Have the students read page 218 and study the pictures. Teacher may paraphrase.
3. Review the steps for making the Model B pinwheel.
4. Review the safety precautions about handling the long pin and keeping it stuck in an eraser when it is not in use. Remind the students that the point is sharp and could hurt them.
5. Divide the students into the same pairs that worked together previously or have them work individually.
6. Distribute the materials and have the students begin to make their pinwheels.
7. Circulate among the students providing help as it is needed.
8. Have the students write down their predictions before testing them. Ask them to observe the curve of the pinwheel blade carefully before they predict how it will turn.
9. Have the students discuss and compare their predictions.
10. Discuss the numbered questions with the students when they have completed testing their predictions. Make sure the students understand that the Model A and Model B pinwheels turn in opposite directions because their blades slope in opposite directions.

DESIRED LEARNING OUTCOME: Demonstrate with a pinwheel that motion in one direction can produce motion in another direction.

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DEVELOPMENT: Lesson Cluster 3C-1 Moving Air and Flying Objects
Page T-364/S-219 String Power (30 min.)

PURPOSE: Enable the students to observe that straight-line motion can produce circular motion.

ADVANCE PREPARATION: Materials - Each child will need:
- paper and pencils
- model A and B pinwheels
- string, 30 cm (1 ft.)

Also have:
- 1 fan, electric (optional)
- 1 piece of tissue paper (optional)

Language Cards/Key Signs
counterclockwise
unbalanced force
pinwheel
predict

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson by briefly discussing how a pinwheel can be used to show that motion in one direction produces motion in another direction.

2. Have the students read pages 219 and 220 and study the pictures. Teacher may paraphrase.

3. Divide the class into the same pairs that worked together in the last lesson or have them work individually.

4. Distribute the pinwheels and string to the students.

5. Discuss the directions with the students. Make sure that they understand how to wind the string around the pinwheel shaft. Demonstrate the process if necessary.

6. Ask the students to write down their predictions before testing them.

7. If the students are not able to make the predictions independently, the lesson may be done as a class activity. Have the students make predictions and record them on the board. Then let each child test the predictions using their pinwheels.

8. Have the students begin to work. Emphasize that they should look directly at the head of the pin when they observe whether the pinwheel is moving clockwise or counterclockwise.

9. Help students who have difficulty winding the string around the shaft of the pinwheel or who tangle their strings.

10. Have the students test their Model B pinwheels as described in the first numbered question.

11. Discuss question 2 with the children. Help them to understand that if blowing on a pinwheel turns it in one direction, then turning the pinwheel in the opposite direction will cause the pinwheel to blow air back at them. Also help them to understand that pulling a string from the top of the shaft on both Model A and Model B pinwheels will cause the blades to turn clockwise even if the two pinwheels blow air in opposite directions. If the students have difficulty in understanding this, draw a diagram on the chalkboard to show the position of the string releative to the saft and pinwheel blades. Use arrows to show the directions of motion.

12. Stress with the students that motion in one direction (pulling on string) causes motion in another direction (turning pinwheel). To demonstrate the concept further, have the students tape one end of the string to the pinwheel shaft and then blow into the pinwheel. By doing this, they should discover that a very small force of air blowing on the pinwheel will cause the string to wind up.

13. Extend the lesson by demonstrating with an electric fan if you have one. First caution the students about sticking their fingers or other objects into the fan. Explain that it is dangerous to do this. Have only a few students go up to the fan at a time so that you may closely supervise them.

14. Turn on the fan at low speed. Hold a strip of tissue paper in front of the fan. Have the students infer the air flow by observing the strip of tissue paper. Explain to the students that the motor inside the fan acts like a continuous string that turns blades. Emphasize that this is an everyday example of motion in one direction producing motion in another direction.

15. Have the students unwind the strings from their pinwheels. Store the string and the pinwheels in a safe place for use in lesson 4 of the next cluster.

16. For the Enrichment Lesson that should be done following this lesson, turn to page T-363.

DESIRED LEARNING OUTCOME: Demonstrate with a pinwheel and string that straight-line motion can produce circular motion.

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ENRICHMENT: Lesson Cluster 3C-1 Moving Air and Flying Objects
Page T-363 Box Kites - Optional (50 min.)

PURPOSE: Demonstrate the change from sideways motion to up motion when air strikes the slanted surface of a box kite.

ADVANCE PREPARATION:

Background Information - Kites have been flown for at least 2200 years, but it wasn't until 1892, 11 years before the first powered flight, that an Australian, Lawrence Hargrave, invented the box kite. The kite was able to fly at great heights and remain stable. Hargrave flew a box kite as high as it could fly and then tied another kite to fly even higher. Hargrave tied two more kites to the string, making a train of four ties lifted 79 kg of weather forecasting equipment (weighing 175 lbs.) 3400 m (11,000 ft.) into the air with kites.

Early aviators, including Wilbur and Orville Wright, experimented with box kites. Alexander Graham Bell, who invented the telephone, designed an airplane using a box-kite design. He also made a box kite that was large enough to carry an army officer 53 m (q75 ft.) off the ground.

Box kites were most often used by the weather bureau. They were flown in trains of three or more kites. The highest kite carried an instrument that could record temperature, barometric pressure, wind velocity, and humidity. Because box kites could not be flown in all kinds of weather, they were later replaced by balloons and airplanes.

Materials - 1 kite

Obtain a box kite that the students can observe in flight. A student may have one that he or she would be willing to bring to class.

Plan the kite flying on a clear and moderately windy day. Make sure that the area you choose to fly the kite is free of power lines and telephone poles.

TEACHING SUGGESTIONS:

1. Introduce the lesson by briefly reviewing how air turns a pinwheel. Stress that as air strikes a slanted surface the air changes direction. Air blowing against the slanted surface, therefore, pushes or exerts a force on that slanted surface.

2. Have the students turn to page 215 and look at the picture. Ask the students if they know the name of the pictured object (box kite).

3. Share and discuss the Background Information with the students.

4. Explain that in the picture on page 215 the wind is blowing from behind the people. Relative to the people, the kite moves upward. The kite changes sideways motion to upward motion.

5. Take the class out to fly the box kite that you have obtained. Ask the students to observe how the motion of the wind in one direction is changed to motion of the kite in another direction.

6. Discuss the following questions with the students as they are flying the kite or in the classroom after they have flown the kite.
   1. Why is it necessary to run into the wind to start the kite flying? (so that air can push against the slanted surfaces of the kite)
   2. What keeps the kite from flying away in the direction of the wind? (the string)
   3. How does a kite fly? (wind hitting the slanted surfaces of the kite exerts an upward force on the kite)
   4. Compare the downward force to the upward force if:
      a. the kite is falling toward the Earth (Downward force is greater.)
      b. the kite is going higher (Upward force is greater.)
      c. The kite is still in mid-air. (The upward force and the downward force are balanced.)

7. Extend the lesson if you wish by having students collect or draw pictures of different kinds of kites for a bulletin board display.

DESIRED LEARNING OUTCOME: Describe how sideways motion is changed to upward motion when air strikes the slanted surfaces of a box kite.

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APPLICATION: Lesson Cluster 3C-1 Moving Air and Flying Objects
Page T-366/S-221 Airplanes (50 min.)

PURPOSE: Apply the concepts of force and motion to the lift on airplane wings.

570

ADVANCE PREPARATION:

Background Information - Put simply, an airplane flies because it has an upward force on it greater than, or equal to, its weight. If you look at the cross section of a wing, you will see that the top surface is curved. Usually the bottom surface is flat or much less curved than the top. As the wing moves, the air passing over the top is forced to move faster than the air moving across the bottom. This faster-moving air exerts less pressure. Thus, there is less presure on the top of the wing than on the bottom. If the force caused by this pressure is equal to, or greater than, the weight of the plane, the plane flies.

Materials - Have the following for each student:
- straight pins, with heads and long
- scissors
- erasers
- paper airplane from Appendix H, page T-538
- book, any
- paper

Also have:
- 1 model airplane
- tape

Duplicate enough copies of the paper plane pattern and instructions so that each student will have one. Obtain one or more model airplanes for the students to study. Some of the students may have models that they would be willing to bring to class.

Language Cards/Key Signs

airplane
force
prediction
upward
lift
slanted
balanced force
unbalanced force
downward

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students how they think airplanes are able to fly. Have several students respond to the question to get a general idea of how much the class already knows about flight.

2. Review the concepts the students have learned about the pinwheel. Stress that when air strikes a slanted surface, part of the force of the air pushes along the slanted surface and part is deflected.

3. Have the students read the first four paragraphs on page 221. Teacher may paraphrase.

4. Distribute the scissors, airplane,patterns, erasers, and pins to the students.

5. Have the students read the directions on the sheet for making the paper plane. Teacher may paraphrase. The teacher may make a plane during class for demonstration.

6. Discuss the directions with them to make sure that they understand how to make the planes.

7. Have the students make the planes and then complete page 221.

8. Discuss the motion of the paper plane with the students when they have completed page 221. Emphasize that they blew air across the book and the plane body and wing went up. This is evidence that motion in one direction caused motion in another

direction. Have the students explain the evidence in terms of force.

9. Have the students read the first paragraph on page 222.

10. Discuss the term lift with the students.

11. Have the students read the directions for the next part of the lesson. Teacher may paraphrase.

12. Distribute the books and paper strips and have the students do the experiment. Make sure that they predict what will happen before blowing across the paper.

13. Have the students read the remainder of the page.

14. Discuss the lesson with the students using the cross section of an airplane wing shown on page 22. Help the students to understand how air rushing around a wing produces lift.

15. Show the class the model airplane. Have the students explain how the airplane can be made to go up and down. If you have collected several models let the students work the models in small groups.

16. Point out the elevators on the plane to the students. (See Figure 3-2). When the elevators are moved up relative to the body of the airplane, air strikes the elevators and pushes the tail section down. This causes the nose of the airplane to drop. The elevators on a wing are adjusted during take off and descent. Be sure to emphasize that air flow over the elevators is another example of motion in one direction causing motion in another direction.

17. Assign the report on airplanes to the whole class or to a few individuals as a free-time activity. Provide time for the students to share their reports during a later class.

DESIRED LEARNING OUTCOME: Describe how forces push on an airplane wing to produce lift.

****

EVALUATION: Lesson Cluster 3C-1 Moving Air and Flying Objects
Page T-368/S-223 Which Way Will It Move? (25 min.)

PURPOSE: Evaluate the students' performance in relation to the following objectives:
1. Describing changes in motion direction caused by forces acting on the curved surfaces of a pinwheel.
2. Drawing arrows to show the direction and relative amounts of force pushing on the top and bottom surfaces of an airplane wing.

ADVANCE PREPARATION: Materials - Each student will need:
- paper, pencils and textbooks

TEACHING SUGGESTIONS:

1. Have the students turn to page 223 and read through the lesson. Teacher may paraphrase.

2. Be certain that the students understand what they are to do.

3. Distribute the materials and have the students do the lesson.

4. Go over the students' responses with them when they have completed their work. If you wish, let the students correct their own papers to enable them to evaluate their own progress.

5. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 3 Motion

Part C Changing Direction, Lesson Cluster 3C-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-374	Introduction	A Screw is a Simple Machine	35 min.
T-376	Development	Paper Spirals	45 min.
T-378	Enrichment*	The Archimedes Screw	45 min.
T-379	Development	Wheel and Axle	30 min.
T-380	Development	Cranks Change Motion	30 min.
T-381	Application	Two in One	45 min.
T-382	Evaluation	The Nuts and Bolts of It	45 min.

*This lesson does not appear in the student text.

B. MATERIALS: Add the following to the Materials List on page T-371
- 1 screw driver
- 1 large screw
- 1 piece of wood
- example of a wheel and axle (door knob, nut and bolt, etc.)
- a hand drill, tricycle and clamp (see p. S-230)
- 1 paper spiral (see page S-231)

INTRODUCTION: Lesson Cluster 3C-2 Simple Machines
Page T-374/S-224 A Screw is a Simple Machine (35 min.)

PURPOSE: To introduce the screw as a simple machine.

ADVANCE PREPARATION:

Background Information - Simple machines can change the direction and the amount of force. They can also change the direction and the amount of motion. When simple machines increase or multiply force, there is a corresponding change in distance or motion. Whatever is gained in force exerted through a short distance is balanced by the exertion of a smaller force through a longer distance - a gain in force balanced by an increase in distance.

Materials - Each student will need - scissors
- unlined paper
- crayons
- tape

Also have - 1 screw driver
- 1 screw
- 1 piece of wood

Language Cards/Key Signs
screw
simple machine
inclined plane
motion
direction

Identification Cards

574

TEACHING SUGGESTIONS:

1. Begin the lesson by introducing or reviewing the terms simple machine and inclined plane. You may want to have student give examples of inclined planes and describe how they work.

2. Have the students read the first two paragraphs on page 224. Teacher may paraphrase.

3. Discuss the paragraphs with the students when they have finished reading. Make sure the students that a simple machine can change motion in one direction to motion in another direction.

4. Have the students read the directions on pages 224 and 225. Teacher may paraphrase.

5. Discuss the directions with the students making sure that they understand what they are to do.

6. Distribute the materials and have the students begin to work.

7. Circulate among the students providing help as it is needed. Have the students turn the "screw" they have made as if they were screwing it into their desks.

8. Teacher should paraphrase information on page 225 and use the screw and screw driver for demonstration.

9. Have students answer the questions.

10. Let the students share their responses as they work.

11. Discuss the questions with the students. Emphasize that a screw is a simple machine made of an inclined plane wound on a cylinder, and that screws change motion in one direction to motion in another direction.

DESIRED LEARNING OUTCOME: Be able to describe how a screw changes motion in one direction to motion in another direction.

****

DEVELOPMENT: Lesson Cluster 3C-2 Simple Machines
Page T-376/S-227 Paper Spirals (45 min.)

PURPOSE: Reinforce concept that a screw changes motion in one direction to motion in another direction.

ADVANCE PREPARATION: Materials - Each student will need the
- 1 scissors
- paper spiral from Appendix I, pages T-539 and T-540
- pencil
- eraser
- straight pin, long and with head

Language Cards/Key Signs
paper spiral
change
motion
direction
clockwise
counterclockwise

Identification Cards

Prepare copies of the paper spiral from Appendix I, page T-539 and 540. The pattern can be dittoed or photocopied.

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing the effect of air blowing against a slanted surface.

2. Ask the students to read the first paragraph on page 226. Teacher may paraphrase.

3. Distribute the paper spiral patterns, erasers, pencils, and scissors to the students.

4. Have the students read the directions for the spirals.

5. Discuss the directions with the students.

6. Have the students make the spirals. Teacher may make one during class for demonstration.

7. Make sure that the students have correctly labeled both sides of their spirals.

8. Distribute the pins to the students. Stick the pins into the erasers that you passed out earlier. Caution the students about using the pins carefully.

9. Have the students proceed with the lesson on pages 226 and 227. Stress that they should make their predictions before doing each experiment.

10. Discuss the lesson with the students when they have completed their work. Go over each of the questions. If conflicting opinions arise, have student demonstrate with a paper spiral to find out who is correct. Stress the comparison of Mark I and Mark II. Have the students compare them and the two pinwheels that they made earlier.

11. Stress that when air blows across a slanted surface part of the force is deflected. Also stress that the experiment with the paper spiral provides additional evidence that motion in one direction can produce motion in antoher direction.

12. Collect and store the paper spirals for use in Convection Currents in the Air on page 246.

DESIRED LEARNING OUTCOME: Ability to demonstrate with a paper spiral that motion in one direction causes motion in another.

****

ENRICHMENT: Lesson Cluster 3C-2 Simple Machines
Page T-378 The Archimedes Screw (45 min.)

PURPOSE: To extend what has been learned about screws to the Archimedes Screw.

ADVANCE PREPARATION:

Background Information - Water enters the opening at the lower end of an Archimedes screw. As the screw is turned, water in the lower part of each turn of the coil gradually moves upward along a line parallel to the axis of the screw.

When the Archimedes screw is turned the same number of times as there are turns in the tubing, the water reaches the top of the screw.

Materials - Each pair of students will need the following:
- tubing, flexible, clear plastic 2m (1 3/4 yards) long and 1 cm (3/8 in.) in diameter*
- 2 rubber bands #33

1 cylinder, plastic, 4 cm x 45.5 cm (1 ½ in. x 14 in.) or rolling pin
- 1 container, rectangular, flat, such as a shallow baking pan
- 1 cup, paper or plastic, 355 ml (12 oz.)
- water

Language Cards/Key Signs
Archimedes Screw

Identification Cards

*You can purchase the clear plastic tubing at a hardward or aquarium supply store.

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they are going to learn about a special kind of screw that can lift water called an Archimedes Screw.

2. Explain to the students that the Archimedes screw is named after a Greek scientist who invented it over 2200 years ago. When Archimedes visited Egypt he saw farmers carrying buckets of water from the Nile River to water their fields. He thought that there must be an easier way to do the job. Archimedes had a carpentar make a big screw that turned inside a wide tube. The screw carried water up the tube from the Nile to the fields. One man turning the screw could do the work of many men carrying buckets.

3. Tell the students that Archimedes screws are still used today to lift water from rivers and wells. They are also used in the Netherlands to move water from the lowlands up to the ocean.

4. Tell the students that they can make an Archimedes screw. Then divide them into pairs.

5. Distribute the materials to each group.

6. Have the students put a rubber band loop around one end of the tubing as shown in Figure 3-3 and then attach it to the end of the cylinder.

7. Have the students then wrap the tubing around the cylinder, making sure that successive windings are close together. Have them use the other rubber band to attach the loose end of the tubing to the cylinder using the same kind of loop as they used before.

8. Have the students set up the equipment as shown in Figure 3-4. The axis of the cylinder must slope gently so that water will stay in the bottom of each coil.

9. Have the students try to lift water from the basin using the Archimedes screw.

10. Discuss the experiment with the students when they all have had a chance to lift water to the top of the Archimedes screw. Ask the students if it makes a difference which way they turn the cylinder (Yes, the open end at the bottom of the coil must dip in and out of the water like a scoop.). Ask the students to describe the movement of the water relative to the ground (moves upward at an angle). Then ask them to describe the movement of the water relative to the axis of the screw (moves parallel to the axis of the screw).

DESIRED LEARNING OUTCOME: Ability to describe the movement of water in an Archimedes screw relative to the ground and relative to the axis of the screw.

****

DEVELOPMENT: Lesson Cluster 3C-2 Simple Machines
Page T-379/S-228 Wheel and Axle (30 min.)

PURPOSE: To introduce the wheel and axle as a simple machine.

ADVANCE PREPARATION: Materials - pinwheels from String Power on page T-219
- string from String Power
- concrete example of a wheel and axle (door knob, wheel and axle of of a toy car or truck, nut and bolt, etc.)

Language Cards/Key Signs
wheel
axle
simple machine
pin wheel

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students read the introductory paragraph on page 228. Teacher may paraphrase.

2. Discuss the terms wheel and axle with the students making sure that they understand their meaning. You may want to sketch a wheel and axle similar to those in the text on the chalkboard and label the wheel and axle. Show the students an actual example of a wheel and axle for demonstration.

3. Have the students read the paragraph and italicized question at the top of the second column.

4. Distribute the pinwheels and strings to the students. Have students identify the wheel and axle parts of the pinwheel.

5. Allow enough time for the students to manipulate the pinwheel and the string.

6. Discuss the italicized question with the students. You may wish to have them estimate the distance that the tips of the blades travel in one turn compared to the distance the string travels in one turn. To do this the students can lay a pinwheel down and circle the tops of the blades with a string. They can then compare the length of the string that circles the pinwheel and the length of string that is wrapped once around the axle.

7. Have the students read and answer the numbered questions. Teacher may paraphrase questions.

8. Let the students discuss their responses with their neighbors as they work.

9. Discuss the students' responses with them when they have completed their work. Stress that a small force moving a great distance can exert a larger force moving a small distance. In other words, the blades of a pinwheel must move a greater distance to wind up a smaller length of string. A small force on the blades of a pinwheel produces a larger force on the axle.

DESIRED LEARNING OUTCOME: Ability to identify the wheel and axle on a pinwheel and explain how a smaller force moving a greater distance can exert a larger force moving a smaller distance.

* * *

DEVELOPMENT: Lesson Cluster 3C-2 Simple Machines
Page T-380/S-229 Cranks Change Motion (30 min.)

PURPOSE: To introduce the crank as a kind of wheel and axle.

ADVANCE PREPARATION: Materials - Each student will need:
- one paper clip and a file-card
- also have 25-30 additional paper clips on hand

Language Cards/Key Signs
cranks
force
distance
circular motion
wheel and axle

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing the wheel and axle with the students. Explain to the students that in this lesson they will learn about a kind of wheel and axle called the crank.

2. Have the students read the paragraph above the first picture to find out how they will make the crank.

3. Discuss the directions with the students making sure they understand what they are to do.

4. Distirbute the file cards and paper clips and let the students begin to work.

5. Circulate among the students providing help as needed.

6. Use pliers to help students who have difficulty bending the paper clips.

7. Provide sufficient time for each student to manipulate his or her crank and answer the first italicized question. Be sure that they observe the edge of the file card from the side when answering the question.

8. Divide the class into pairs and have the students follow the direction in the paragraph at the end of the first column on page 229.

9. Another way for the students to observe the change from circular to up and down motion is this:
   a. Have them replace the card with a chain of three to five paper clips.
   b. Now have them hold their cranks between their thumbs and index fingers so that the bottom of the chain is at eye level.
   c. Have them slowly rotate their cranks. The bottom clip will move up and down as the crank is turned.

10. Have the students answer and discuss the numbered questions.

DESIRED LEARNING OUTCOME: Ability to describe the crank as a kind of wheel and axle and describe how cranks can change circular motion to motion that is up and down relative to the ground.

****

APPLICATION: Lesson Cluster 3C-2 Simple Machines
Page T-381/S-230 Two in One (45 min.)

PURPOSE: To apply what has been learned about simple machines to complex machines that consist of 2 or more simple machines.

ADVANCE PREPARATION: Materials - a drill, clamp and tricycle as pictured on page S-230

Language Cards/Key Signs
simple machine
force
wheel and axle
crank
screw

Identification Cards

TEACHING SUGGESTIONS:

1. Review the different simple machines that the students have studied so that they will know what to look for in the pictures.

2. Have the students read the first paragraph on page 230.

3. Teacher should write drill (A), tricycle (B) and clamp (C) on the board. Through discussion, manipulation of the 3 machines and examination of the pictures the class should answer the first italicized question and record the answers on the board. Thenproceed to the next two questions. Most of the students will have little difficulty with the brace and bit pictured in A or C clamp pictured in C. The tricycle, like a bicycle, is designed to produce a greater speed not a greater force. A greater force must, therefore, be exerted on the pedals to turn the front wheel. The front wheel moves a greater distance than the pedals and exerts a smaller force relative to the pedals. The handlebar of the tricycle is another wheel and axle. The two back wheels may not be wheel and axles because the wheels are usually not attached rigidly to the axle.

4. Have the students read and discuss the numbered questions. You may want to list the machines that the students name on the chalkboard. If possible the students should bring in small machines, or the teacher may do so. Set aside an area to display the machines and ask the students to name the simple machines that make up each one.

DESIRED LEARNING OUTCOME: Ability to name some simple machines inside complex ones.

****

EVALUATION: Lesson Cluster 3C-2 Simple Machines
Page T-382/S-231 The Nuts and Bolts of It (45 min.)

PURPOSE: To evaluate students' performance in relation to the following objectives:

1. Naming the simple machine to which the bolt is related.
2. Determine whether the distance a nut moves towards the end of a bolt or the distance it moves in a circle is greater.
3. Naming the direction a paper spiral will move when a person blows on it.
4. Naming an object that can change motion in one direction to motion in another.

ADVANCE PREPARATION: Materials - Each student will need:
- a nut and bolt as pictured on page 231
- a paper spiral as pictured on page 231
- paper and pencil

TEACHING SUGGESTIONS:

1. Have the students turn to page 231 and read through the lesson. Teacher may paraphrase.

2. Distribute the materials and have the students do the lesson. Explain that they may use the materials as they are used in the picture to help them find the answer.

3. Go over the students' responses with them when they have completed their work. If you wish, let the students correct their own papers to enable them to evaluate their own progress.

4. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 3 Motion

Part C Changing Directions, Lesson Cluster 3C-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-388	Introduction	Wheels That Touch	60 min.
T-390	Introduction	Using Gears	45 min.
T-392	Development	The Pulley	45 min.
T-394	Enrichment*	More Pulleys	45 min.
T-396	Development	Wheels That Don't Touch	30 min.
T-397	Application	A Bicycle System	30 min.
T-398	Evaluation	Know Your Machines	30 min.

*This lesson does not appear in the student text.

B. MATERIALS: Add the following to the Materials List on page T-384:
- a model of 2 gears working together (as on page 233)
- a model of a gear system (machine, toy, clock)
- 10-speed bicycle

FILMSTRIP INFORMATION: Filmstrip Set VII, Place and Motion and XV, Relative Motion are approrpaite for use in this unit.

INTORDUCTION: Lesson Cluster 3C-3 Motion and Machines
Page T-388/S-232 Wheels That Touch (60 min.)

PURPOSE: Introduce gears as simple machines and reinforce the concept that a small force moving a large distance can cause a large force to move a small distance.

ADVANCE PREPARATION: Materials
- Each pair of students will need:
- scissors, pair
- a circle, 10 cm in diameter as a model for tracing their own cardboard circle. A jar lid, roll of masking tape or cardboard form may be used.
- 1 pencil with an eraser
- 1 nail with flat head
- 2 15 cm squares of corrugated cardboard

Language Cards/Key Signs
wheels
gears
teeth

You may wish to put 1 set of materials together in advance to show the class the completed wheel. Also have a model of 2 gears working together (toy, machine, clock)

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to think of machines having wheels that touch. Some students may be familiar with gears in building sets, or wind-up toys, clocks, or watches. After a brief discussion, tell the students that they are going to learn about these kinds of wheels.
2. Have the students read the directions for the activity on pages 232 and 233.
3. Discuss the directions with the students. Stress the need to get the nail or brad as close to the center of the circle as possible, for best results. If you have already made one show the students finished model.
4. Divide the class into groups of two and distribute the materials. Have them begin making the wheels.
5. After the wheels are prepared, have the students proceed with the activity. Explain that one students can concentrate on turning the wheel with the pencil while the other counts the pencil turns. Stress that the pencil should always be kept in the same position while the wheel is turning.
6. Discuss with the class the number of pencil turns it took to turn the wheel one turn. You may wish to chart the results on the chalkboard.
7. Assess the enthusiasm of the students at this point. If they are tired you may wish to have them continue with the remainder of page 233 another day.
8. Have the students read column one on page 233. The teacher may paraphrase the directions and demonstrate the procedure for the class.
9. Complete the lesson by reading and answering the questions in column two. Use the model of gears to demonstrate how 2 gears work together.
10. Make sure the students understand that when gears or wheels are touching, one turns clockwise and the other turns counterclockwise. Emphasize that gear systems may be used to change direction, and to increase force or distance. Gear systems can apply a small force over a large distance to exert a large force over a small distance.

DESIRED LEARNING OUTCOME: Ability to determine the number of revolutions a small wheel makes in turning a large wheel one revolution, determine the direction that one wheel will turn when the direction of the other wheel is known, and describe how to use gears to increase force, and speed or distance.

****

INTRODUCTION: Lesson Cluster 3C-3 Motion and Machines
Page T-390/S-234 Using Gears (45 min.)

PURPOSE: Introduce gear systems.

ADVANCE PREPARATION: Materials -model of a gear system

Language Cards/Key Signs	
gears	motion
clockwise	direction
gear system	force
counter clockwise	

TEACHING SUGGESTIONS:

1. Introduce the lesson by having the students tell about their experiences with gear systems in toys and machines. Use the model of a gear system to demonstrate how gears move.

2. Have students read introductory paragraph and study the pictures. Teacher may paraphrase and use the model for clarification.

3. Explain to the students that they will be using two gear systems to answer questions. Emphasize that in the second gear system, gears D and E are rigidly connected; one gear cannot turn without turning the other.

4. Have the students read the page and answer the questions. This may be done as a class discussion.

5. Emphasize that when one gear turns another, they go in opposite directions. The third gear in a series goes in the same direction as the first gear. It may help to sketch a series of four or six gears on the chalkboard to show this relationship.

6. Stress that a small force moving through a large distance can exert a large force through a small distance.

7. You may also wish to develop a bulletin board of pictures of machines that are made of gears and wheels. Most local car dealers have brochures with pictures of transmissions and other auto parts. Pictures of bulldozers, power shovels, and other power equipment that contain wheels and gear systems may be found in magazine and newspaper advertisements.
   You may also want to have students draw pictures of gear systems of a real or imagined machine. Stress that they do not have to draw teeth on the gears. They need only draw arrows to indicate the direction of rotation of each of the gears.

DESIRED LEARNING OUTCOME: Ability to determine the direction gears will turn in a gear system if the direction of one gear is known.

* * *

DEVELOPMENT: Lesson Cluster 3C-3 Motion and Machines
Page T-392/S-235 The Pulley (45 min.)

PURPOSE: To extend the concept of simple machines by introducing the pulley, and to demonstrate that a small force moving a large distance can exert a large force through a small distance.

PREREQUISITES: Ability to measure in cm.

ADVANCE PREPARATION: Materials -2 sticks each about 30 cm long (pieces of a broom handle would be fine)
-rope, about 3 m long

Language Cards/Key Signs

pulley
force
frame
wheel
prediction
pulley system
axle
weight
direction

TEACHING SUGGESTIONS:

1. Select three students, A, B, and C, to do the demonstration that is pictured on page 235. Before the demonstration the class should predict whether student A can pull students B and C together. Make sure that the students wear gloves to prevent rope burn.
2. Have one of the three students tie the end of the rope to one of the sticks. Check to make sure the rope is secure.
3. Have the other two students loop the rope around the sticks as illustrated. Before they actually test the system, have Student A gently pull the rope several times as the other students put just a small amount of force on the system. Make sure the Students B and C hold their sticks parallel to each other.
4. Have the students test their predictions, and then discuss whether or not their predictions were correct.
5. Have the students read the remainder of page 235 to find out how to take the measurements. You may choose one student to measure the distance between Students B and C and one student to measure the 50 cm for Student A.
6. Discuss the measurements with the students when they have completed this part of the lesson. Be sure that the students understand that the small force exerted by Student A over a large distance exerts a large force on the sticks over a short distance.
7. Have the students read page 236 and answer the numbered question. Teacher may paraphrase.
8. Discuss the lesson with the students. Stress that each of the loops of rope around the stick acts like a pulley. Help students compare the demonstration with the block and tackle pictured on page 236. Stress that the pulley is a common simple machine. It is a device that changes the amount or direction of forces.

DESIRED LEARNING OUTCOME: The students should be able to identify a pulley as a simple machine that can change the direction of a force and permit a small force moving a large distance to exert a larger force moving over a smaller distance.

****

ENRICHMENT: Lesson Cluster 3C-3 Motion and Machines
Page T-392/S- More Pulleys (45 min.)

PURPOSE: To further extend the concept of pulleys by comparing several pulley systems for force and distance, and to introduce the terms fixed pulley, movable pulley, and block and tackle. We recommend this activity for students who can deal with more challenging tasks. The lesson may be simplified by only building the 3 pulleys and comparing them to a simple pulley.

ADVANCE PREPARATION: Materials - paper clips
washers
thread or fishing line

Language Cards
pulley
fixed pulley
movable pulley
block and tackle
distance
force

Instructions for Making a Pulley System

Place the spools on the board so that their centers are about 10 cm (4 in.) apart. (See picture A, page T-396). Put a nail through the center shaft of each spool and hammer the nails into the board. The spools should be free to spin. Draw an arrow on the end of each spool from the center shaft to the rim. Stretch a rubber band over the spools. Turn one spool to make sure the other spool will turn. If you have difficulty making both wheels turn, try using other rubber bands until both spools turn easily.

Collect the paper clips and washers. If you are unable to obtain washers you may use other small objects with a 20-50 g mass (weighing 1 oz.-2 oz.). Make sure, however, that any objects you choose can be easily attached to a line or paper clip.

Cut monofilament thread or fishing line into sections so that each group of three will have two pieces 10 cm (4 in.) long and one piece 60 cm (24 in.) long. For each group, package the three pieces of thread or line, two paper clips and a washer.

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they will be making three pulley systems to compare changes in force and distance.

2. Provide an area for those students doing the activity to work. If a number of students are involved, divide them into groups of three and distribute materials.

3. Have the students attach a washer to the paper clip and line as shown in Figure 3-5.

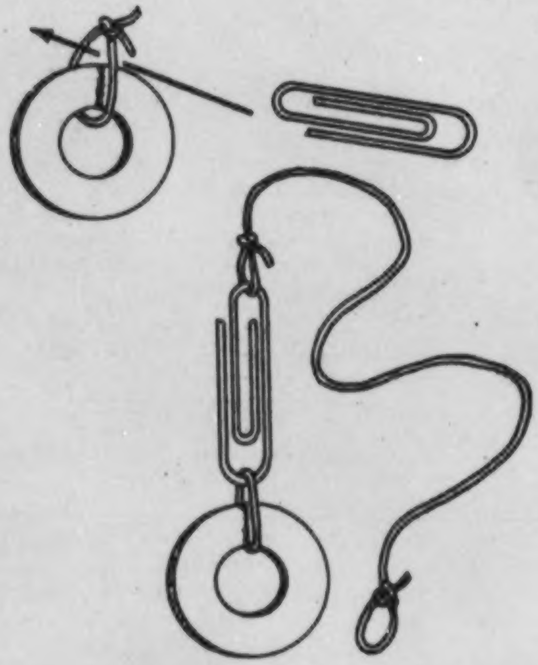

Figure 3-5. Washer, Paper Clip, and Line Assembly

4. Let the students in each group take turns holding the unattached end of the line to feel the amount of force pulling downward. If spring scales are available, have the students measure and record the force.

5. Have the students make a fixed pulley and tape it to the bottom of a desk, as shown in Figure 3-6.

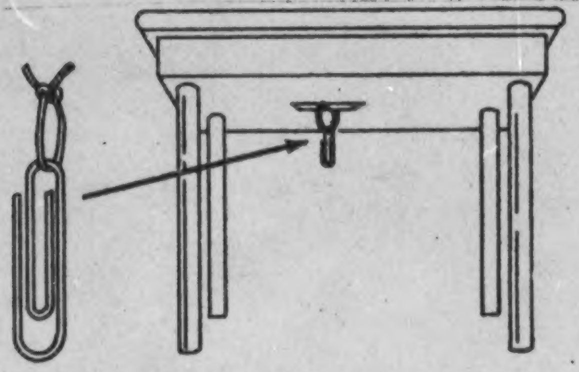

Figure 3-6. Fixed Pulley Attached to Desk

6. Explain to the students that the fixed pulley they have made from a paper clip will act as a pulley wheel. Further explain that it is called a fixed pulley because it remains in the same position.

7. Have the students make Pulley System I as shown in Figure 3-7.

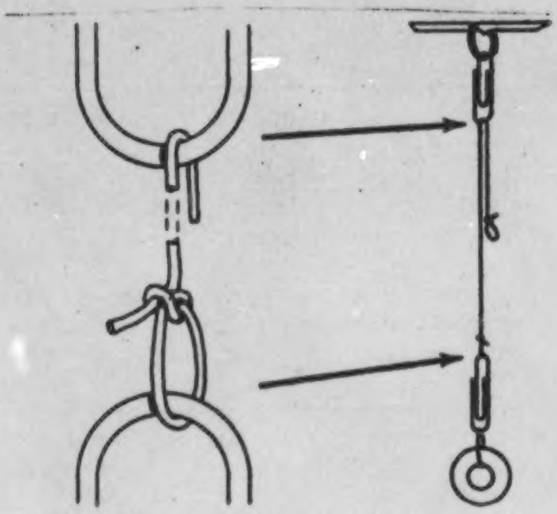

Figure 3-7. Pulley System I

8. Explain to the students that in the pulley system, the long line is separated into two sections by the fixed pulley. The line section that connects the washer to the fixed pulley (left line section in Figure 3-7) is called a support line section because it supports the washer.

9. Ask the students to move the washer up by pulling down on the opposite end of the line. Provide enought time for all students to try this.

10. Ask the students if they think the force needed to lift the washer has changed. (Theoretically, the amount of force should not change, but due to friction the actual force required increases.)

11. Have the students measure the change in distance. One student should move the free end of the line 4 cm, while another student measures the distance the washer travels (4 cm). Students should discover that the distance the washer travels is equal to the distance they pull the line.

12. Have the students make Pulley System II, as shown in Figure 3-8. To prevent the line from tangling, one student should hold a pencil between the line sections.

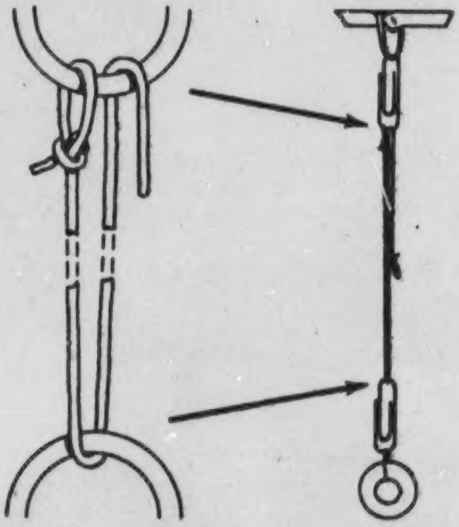

Figure 3-8. Pulley System II

13. Explain to the students that the paper clip attached to the washer serves as a movable pulley. Have the students pull down on the loose end of the line, then challenge them to explain why the paper clip can be called a movable pulley. (It can move up and down.)

14. Explain to the students that when two or more pulley wheels connected with rope or line are used in a pulley system, the system is called a block and tackle. By making Pulley System II, they have constructed a block and tackle.

15. Ask the students how many support lines are in Pulley System II (two, the two lines on the left in Figure 3-8). If students have trouble identifying the support line sections, ask them which line sections are attached to, and support, the washer.

16. Have the students take turns pulling the loose end of the line to feel the force needed to lift the washer. If spring scales are available have the students measure and record the force. Theoretically, only half as much force is needed to lift the washer as compared to Pulley System I. Actually the force needed is more than half due to friction.

4. Let the students in each group take turns holding the unattached end of the line to feel the amount of force pulling downward. If spring scales are available, have the students measure and record the force.

5. Have the students make a fixed pulley and tape it to the bottom of a desk, as shown in Figure 3-6.

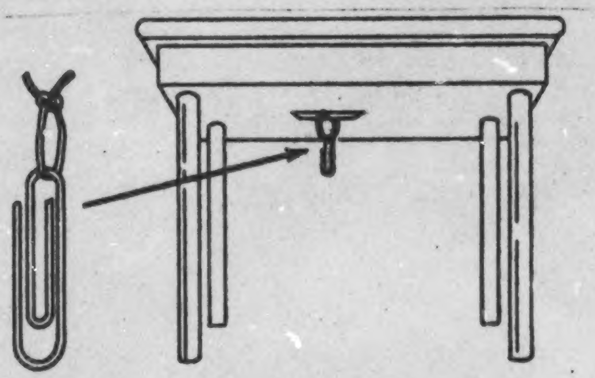

Figure 3-6. Fixed Pulley Attached to Desk

6. Explain to the students that the fixed pulley they have made from a paper clip will act as a pulley wheel. Further explain that it is called a fixed pulley because it remains in the same position.

7. Have the students make Pulley System 1 as shown in Figure 3-7.

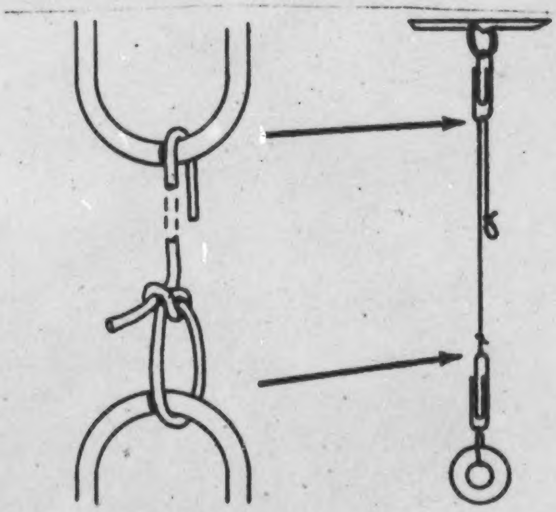

Figure 3-7. Pulley System I

8. Explain to the students that in the pulley system, the long line is separated into two sections by the fixed pulley. The line section that connects the washer to the fixed pulley (left line section in Figure 3-7) is called a support line section because it supports the washer.

9. Ask the students to move the washer up by pulling down on the opposite end of the line. Provide enought time for all students to try this.

10. Ask the students if they think the force needed to lift the washer has changed. (Theoretically, the amount of force should not change, but due to friction the actual force required increases.)

11. Have the students measure the change in distance. One student should move the free end of the line 4 cm, while another student measures the distance the washer travels (4 cm). Students should discover that the distance the washer travels is equal to the distance they pull the line.

12. Have the students make Pulley System II, as shown in Figure 3-8. To prevent the line from tangling, one student should hold a pencil between the line sections.

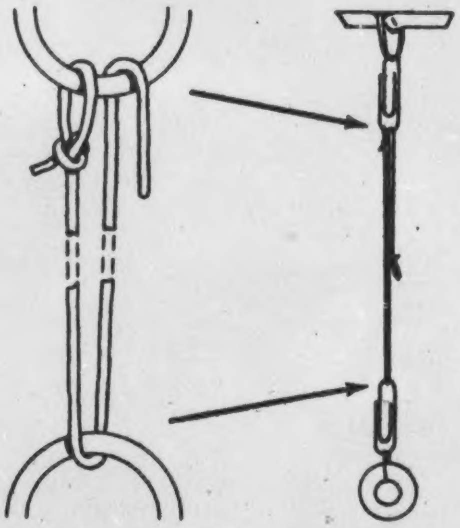

Figure 3-8. Pulley System II

13. Explain to the students that the paper clip attached to the washer serves as a movable pulley. Have the students pull down on the loose end of the line, then challenge them to explain why the paper clip can be called a movable pulley. (It can move up and down.)

14. Explain to the students that when two or more pulley wheels connected with rope or line are used in a pulley system, the system is called a block and tackle. By making Pulley System II, they have constructed a block and tackle.

15. Ask the students how many support lines are in Pulley System II (two, the two lines on the left in Figure 3-8). If students have trouble identifying the support line sections, ask them which line sections are attached to, and support, the washer.

16. Have the students take turns pulling the loose end of the line to feel the force needed to lift the washer. If spring scales are available have the students measure and record the force. Theoretically, only half as much force is needed to lift the washer as compared to Pulley System I. Actually the force needed is more than half due to friction.

17. Have one student in each group pull the loose end of the line 4 cm, while another student measures the distance the washer travels (2 cm). Have the students repeat this, moving the loose end of the line a different distance each time. The students should conclude that the washer will move one-half the distance the line is pulled.

18. Discuss this part of the lesson with the students, having them compare both pulley systems, Pulley System , which has a fixed pulley wheel and one support line section, chan change the direction of a force and can change motion in one direction to motion in another direction. Pulley System II, which has a fixed pulley wheel, a movable pulley wheel, and two support line sections, not only can change the direction of force and motion, but can also change the amount of force and corresponding distance or motion.

19. Have the students predict changes in force and distance in a pulley system having three supporting line sections.

20. Have the students make Pulley System III, as shown in Figure 3-9, to test their predictions. To prevent the line from tangling, students should hold pencils between the line sections.

21. Have the students again measure changes in force and distance needed to move the washer. Theoretically, it takes about one-third the force to move the washer, but it is necessary to pull the line three times the distance that the washer moves.

22. Discuss the lesson with the students. Remind the students that in Pulley Systems II and III they had to thread line around the paper clips more than once. Explain that in most blocks and tackles, pulley wheels are added so that a line or rope will go over each wheel only once. Stress that when support line sections and pulley wheels are added to a block and tackle, less force is needed, but over a greater distance.

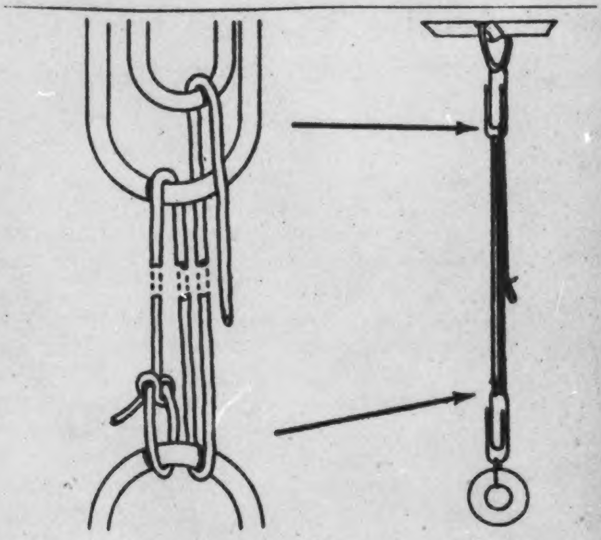

Figure 3-9. Pulley System III

DESIRED LEARNING OUTCOME: The students should be able to identify a fixed pulley wheel, a movable pulley wheel, and a block and tackle.

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DEVELOPMENT: Lesson Cluster 3C-3 Motion and Machines
Page T-396/S-237 Wheels That Don't Touch (30 min.)

PURPOSE: To extend the concept of simple machines by introduxing pulley systems with belts and chains.

ADVANCE PREPARATION: Materials
-2 spools, such as from thread; must be of 2 different sizes
-2 nails, 6-8 cm (2½ in.-3 in.) long
-1 rubber band, size #33
-1 board, 10 cm x 20 cm (4 in. x 8 in.)
-1 hammer
-1 felt tipped pen to mark spools

Language Cards/Key Signs
pulley system
belts
chains
force
direction
motion
speed

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students read the first two paragraphs on page 237.

2. Ask the students if they have ever seen machines in which pulleys with ropes, chains, or belts are used. Some students may be familiar with the belt on a sewing machine, a fan belt in a car engine, or a bicycle chain.

3. Show the class the pulley system you have made and name each part. Point out the arrows used as markers.

4. Have a student turn the appropriate spool on the demonstration pulley system, while the remainder of the class responds to the related italicized questions. If several pulley systems are avilable, have small groups read through the directions and answer the questions. During discussion the groups can compare results.

6. Have the students read the numbered questions at the bottom of the page. Then discuss the directions with the students and indicate whether they should make or draw a pulley system.

7. Discuss the students' responses with them when they have completed their work.

8. Conclude the lesson by asking students how the pulley systems in pictures A and B can change the direction and the speed of motion. Make sure that the students understand that in picture A the pulleys go in the same direction' in picture B they go in opposite directions. Also, the smaller of the two pulleys in each picture makes more revolutions than the larger pulley.

DESIRED LEARNING OUTCOME: The students should be able to identify the direction spools will turn in pulley systems with crossed and uncrossed bands and explain that if the smaller of two wheels in a pulley system makes one complete revolution, the larger wheel makes less than one revolution.

****

APPLICATION: Lesson Cluster 3C-3 Motion and Machines
Page T-397/S-238 A Bicycle System (30 min.)

PURPOSE: To apply what the students have learned about pulley systems to a bicycle pulley system.

ADVANCE PREPARATION: Materials -1 10-speed bicycle

Language Cards/Key Signs
pulley system
bicycle
crank
belt
chain

TEACHING SUGGESTIONS:

1. Have the students read the introductory paragraph on page 238 and identify parts of the pulley system in the picture.

2. Using the 10-speed bicycle in the classroom ask the students to count the number of teeth on the sprocket wheels and then predict how many times the back wheel will turn if the pedal makes one complete turn.

3. Have the students test their predictions. Have several students lift the back wheel while another students slowly turns the pedal. You may have to exert a slight pressure on the back wheel to stop it from spinning after the pedal has made a somplete turn.

4. Have a student demonstrate how to shift gears while one student turns the pedal and other students lift up the back of the bicycle. Each time the student shifts gears, have other students describe what is happening.

DESIRED LEARNING OUTCOME: The students should be able to explain how a bicycle pulley system changes speed or distance of motion and count the number of revolutions the small sprocket wheel makes when the large sprocket wheel makes one complete turn.

****

EVALUATION: Lesson Cluster 3C-3 Motion and Machines
Page T-398/S-239 Know Your Machines (30 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Inferring the direction a gear and a pulley wheel will turn.
2. Calculating the number of turns a large gear will make if a smaller gear makes a known number of turns.
3. Identifying the gear to which a motor should be attached to increase force; identifying the pulley wheel to which a motor should be attached to increase speed or distance.
4. Listing the names of pictured machines.
5. Estimating how far an object connected to a pulley system would move if a person pulled the end of the rope a known distance.

TEACHING SUGGESTIONS:

1. Have the students turn to pages 239 and 240 and read through the lesson. Teacher may paraphrase.

2. Be certain that the students understand what they are to do and then let them answer the questions.

3. Go over the students' responses with them when they have completed their work.

You may want the students to correct their own papers to enable them to evaluate their own progress.

4. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

* * *

Level 5 Unit 4 Matter and Energy

Part A Transfer of Energy, Lesson Cluster 4A-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-410	Introduction	Energy Transfer	30 min.
T-411	Development	Conductors and Insulators	Part 1 35 min. Part 2 35 min.
T-412	Enrichment	Some Do, Some Don't	30 min.
T-413	Development	Conduction	25 min.
T-414	Development	Connection Currents in the Air	50 min.
T-416	Development	Connection Currents in Liquids	30 min.
T-417	Application	Room Air Currents	30 min.
T-418	Evaluation	Energy Movements	35 min.

NOTE: Enrichment lesson is not optional.

B. MATERIALS: Add the following to the materials list on page T-407:
- 1 hot plate
- 1 sauce pan
- 1 can of soup or water

1 supply of hot and cold water, about 2 cups of each

INTRODUCTION: Lesson Cluster 4A-1 Conduction and Connection
Page T-410/S-243 Energy Transfer (30 min.)

PURPOSE: To review or introduce the concepts of energy giver, energy receiver, and energy transfer.

ADVANCE PREPARATION: Materials - hot plate
sauce pan
soup or water

TEACHING SUGGESTIONS:

1. Introduce the unit by explaining to the students that in this unit they are going to learn more about how matter and energy are related. Review the terms matter and energy.

2. Have the students read the title of Part A and look at the picture on page 242. Explain that in this part they are going to find out more about energy transfer.

Language Cards/Key Signs
matter
energy
energy transfer
energy giver
energy receiver
connection
conduction
object
process

Identification Cards

3. Have the students read the title of the first lesson cluster on page 243. Tell the students that they are first going to study energy transfer by conduction and convection.

4. Ask the students read the first two paragraphs on page 243 to review or find out what the process of energy transfer is. Teacher may paraphrase.

5. Use the hot plate, pan and soup/water to demonstrate the energy transfer that is explained in the lesson.

6. Be sure that the students can distinguish between energy givers and receivers and understand that a change in an object is evidence of energy transfer. Make sure the students understand that energy givers and receivers are objects, while energy transfer is a process.

7. Have the students read the remainder of page 243 and answer the questions. Teacher may paraphrase.

8. Discuss the questions with the students. Write the headings Energy Giver, Energy Receiver and Evidence of Energy Transfer on the chalkboard. Ask a student to go to the board and list the energy and energy receiver in the soup-warming system. Ask another student to write a phase that describes the evidence of energy transfer in the system. Have other students follow the same procedure for the soup-cooling system. Draw arrows between the energy givers and energy receivers listed on the board to indicate energy transfer.

DESIRED LEARNING OUTCOME: The students should be able to identify the energy givers and energy receivers in systems and to describe changes in objects as evidence of energy transfer.

****

DEVELOPMENT: Lesson Cluster 4A-1 Conduction and Convection
Page T-411/S-244 Conductors and Insulators (35 min. - 35 min.)

PURPOSE: To review or introduce the concept of conductors and insulators.

PREREQUISITES: Ability to identify conductors and insulators in electrical systems. These concepts are introduced in unit 4 of the fourth grade level. If the students do not have these prerequisites they should do Part One of this lesson.

ADVANCE PREPARATION: Each pair of students will need the following for Part One of lesson:
- 1 flashlight battery, size D, 1.5 volts
- 1 flashlight bulb, size 13
- 2 wires, aluminum, uninsulated, 20 guage, on 10 cm long and the other 5 cm
- masking tape
- scissors
- pencil, with eraser
- paper clip
- ruler, plastic

Language Cards/Key Signs
conductors
insulators
energy
energy giver
energy receiver
energy transfer

Identification Cards

Materials for Part Two - battery, light bulb and 10 cm of wire as in Part One
- 1 metal ruler
- 1 plastic drinking straw

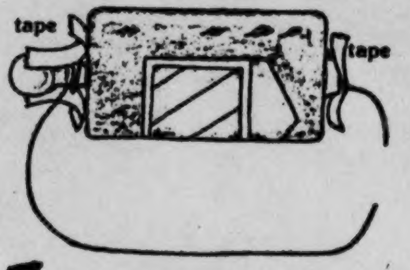
TEACHING SUGGESTIONS:

Part One

1. Divide students into pairs and distribute materials.

2. Have students follow these directions and answer the question:

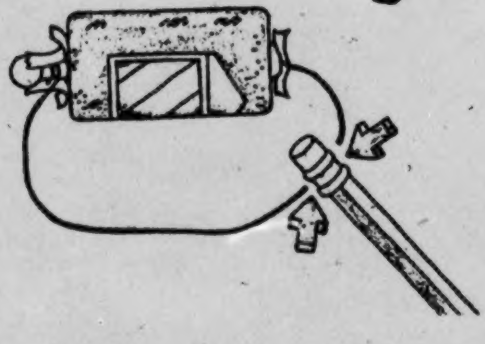
Use one battery, one bulb, two wires, and tape to make a tester. Connect the objects the way that the objects in picture A are connected.



A

Find out if your tester works. Touch the wires together. The bulb should light. If your tester does not work, check the wires. Make sure that the wires are tightly connected. If the tester still does not work, the bulb may be dead. Try a new bulb. When the tester works, you are ready to test different kinds of matter with it. You can find out which kinds of matter are conductors of electricity and which kinds are insulators. Use a pencil with an eraser, a paper clip, a plastic ruler, a metal washer, and paper. Test each object by putting it between the ends of the two wires. First test the pencil. Test each kind of matter in the pencil separately. Test the part that holds the eraser. Place the end of one wire on one side of it and the end of the other wire on the other side. Picture B shows you how to arrange the objects.

B



Be sure that both ends of the wire touch the part of the pencil that you are testing. Is the part of the pencil that holds the eraser a conductor a conductor or an insulator? A. Conductor.
What kind of matter is it made of? B. Metal
Now test the point of the pencil.
Is it a conductor or an insulator? C. Conductor
What kind of matter is it made of? D. Graphite
Test the colored part of the pencil. Then test the eraser and the sharpened part next to the point.
Which parts are conductors? E. None.
Which parts are insulators? F. Colored part; eraser; sharpened part.
What kind of matter is each part made of? G.
Test the other objects. Test them in the same way. Find out if they are conductors or insulators. G. Colored part: paint.
Eraser: rubber.
Sharpened part: wood.

1. Name some kinds of matter that are good conductors of electricity.
   Metals; matter that has some metal in it.
2. Name some kinds of matter that make good insulators.
   Wood; paint; rubber.
3. What would you know about matter that makes the bulb light brightly?
   Excellent conductor; probably pure metal.

Part Two

1. Introduce the lesson by reviewing the concepts of energy giver, energy receiver, and energy transfer. Be sure students remember that energy givers and receivers are objects, whereas energy transfer is a process.

2. Have the students read the first paragraph on page 244. Teacher may paraphrase.

3. Discuss the terms conductor and insulator with the students, making sure that they understand the meanings of the terms.

4. Have the students read the rest of the lesson and answer the questions. Caution them to observe each of the pictures carefully. Use the materials to demonstrate what the lesson describes.

5. Discuss the first question with the students. Ask them how they know the wire is a conductor. Be sure that understand that the lighted bulb is evidence that energy transferred through the wire from the battery.

6. Discuss the questions relating to pictures B and C. Be sure students understand that in picture B the lighted bulb is evidence of energy transfer between the battery and the bulb through a conductor (the wire), and that the unlit bulb in picture C is evidence that no energy transferred from the battery to the bulb because the plastic straw is an insulator.

7. Have the students discuss the numbered questions at the end of the lesson. Ask students to name other materials of which Maria's soup pan could have been made. Ask them if heat energy would have been transferred in the soup-warming system if a non-metallic cooking pot had been used.

DESIRED LEARNING OUTCOME: The students should be able to distinguish between conductors and insulators.

* * *

ENRICHMENT: Lesson Cluster 4A-1 Conduction and Convection
Page T-412 Some Do, Some Don't (30 min.)

PURPOSE: To provide further practice in distinguishing between conductors and insulators. This lesson does not appear in the student text. This lesson should be done following (2) Conductors and Insulators.

ADVANCE PREPARATION: Materials - Each pair of students will need:

- 1 flashlight battery, size D, 1.5 v
- 1 flashlight bulb, size 13
- 10 cm of aluminum, uninsulated wire, 20 gauge
- 1 set of conductors and insulators such as metal and plastic spoons, chalk, paper clips, paper, rubber bands, metal washers, string, aluminum foil, pencils

Refer to Teaching Suggestions in Part One of previous lesson for directions on making the battery system.

Language Cards/Key Signs
conductors
insulators
predict

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing the concepts of conductors and insulators.

2. Draw a three-column chart on the chalkboard. Label the first column "Objects," the second column "Conductor," and the third column "Insulator." List the objects in one of the sets that you have collected in the first column of the chart on the board. Ask the students to predict which of the objects are conductors and which are insulators. Place a check in the proper column on the board as they give their responses. Save the chart so that the students may later check the accuracy of their predictions.

3. Explain to the students that they are going to test their predictions.

4. Divide the class into groups of two.

5. Distribute a set of objects, a battery, a bulb, a piece of paper, and a pencil to each pair of students.

6. Ask the students to list the objects on the paper.

7. Tell the students that after they test each object they are to write either "conductor" or "insulator" beside each object listed on their papers.

8. Have the students begin to test their objects and record their results.

9. Refer the students to the chart on the chalkboard. Have them determine which of their predictions were correct. Have them write "yes" by correct predictions and "no" by incorrect predictions.

10. Ask the students to name the conductors in their collections of objects. List the conductors on the chalkboard.

11. Ask the students to name the conductors in their collections of objects. Most of them will probably be able to figure out that good conductors of electricity are made of or contain metal.

DESIRED LEARNING OUTCOME: The students should be able to distinguish between electrical conductors and insulators by testing them in an electric circuit.

* * *

DEVELOPMENT: Lesson Cluster 4A-1 Conduction and Convection
Page T-413/S-245 Conduction (25 min.)

PURPOSE: To introduce the term conduction.

ADVANCE PREPARATION: Materials - container of hot water
- container of cold water

TEACHING SUGGESTIONS:

1. Ask the students to read the first two paragraphs of the lesson on page 245 to find out what conduction is. Teacher may paraphrase.

2. Make sure the students understand that conduction is the transfer of energy through or along a conductor from an energy giver to an energy receiver. Use the hot and cold water to demonstrate the transfer of energy as described in paragraph one.

Language Cards/Key Signs
conduction
insulators
energy giver
energy receiver
energy transfer

Identification Cards

3. Have the students read the rest of the lesson and answer all the questions. Teacher may paraphrase.

4. Discuss the italicized questions with the students. Then ask the students how electricity travels from power plants to their homes. You might ask them to trace the power lines from school to the power plant or a nearby transformer station. Be sure the students relate the concept of energy giver to the power plant and the concept of energy receiver to their homes. Ask the students where they think electricity would be transferred if the power lines at a power plant touched the towers (to the ground).

5. Discuss the numbered questions with the students. If they have difficulty in thinking of examples of energy transfers, suggest that they think about home appliances. Ask the students how such appliances as toasters and refrigerators provide evidence transfer from power lines to the appliances.

DESIRED LEARNING OUTCOME: The students should be able to describe conduction in terms of the transfer of electricity from a power plant to their homes.

* * *

DEVELOPMENT: Lesson Cluster 4A-1 Conduction and Convection
Page T-414/S-246 Convection Currents in the Air (50 min.)

PURPOSE: To extend the concept of energy transfer to convection currents.

ADVANCE PREPARATION: Materials - Each group of three students will need:
- 1 paper spiral from "Paper Spirals" on page T-226
- 1 small lamp

You will also need:
- 2 erasers, chalkboard, with chalk dust
- 1 hot plate, 120 volts
- 1 slide or filmstrip projector

Language Cards/Key Signs
convection
energy transfer
conduction
convection current
clockwise
counterclockwise

Identification Cards

TEACHING SUGGESTIONS:

1. Ask the students to read the first two paragraphs on page 246 to find out how energy can be transferred by convection currents. Teacher may paraphrase.

2. Be sure the students understand that convection is a process by which energy transfers through moving matter, or convection currents, and that moving air can be a convection current. If the students are not going to do the experiments on page 246, refer them to page 227 of MOTION now. Then continue with suggestion 11.

3. Divide the class into groups of 3.

4. Have the students read through the rest of page 246 to find out what they are going to do.

5. Emphasize the Caution on page 246 with the students.

6. Assign each group to one of the small lamps set up around the room and distribute a spiral to each group.

7. Have the groups begin to work. Remind them to answer all the italicized questions on page 246.

8. Discuss their results with the students.

9. Collect and store the paper spirals for use in lesson 6, Room Air Currents, on page 249.

10. Ask the students to read the first paragraph on page 247. Teacher may paraphrase.

11. Turn on the projector and have a student clap the two chalk-filled erasers in the beam of light. Be sure that the erasers are clapped in a direction away from where the students are.

12. Help the students to relate the motion of the chalk dust particles to energy transfer through convection currents in air.

13. Have the students read the rest of column 1 on page 247 and column 2 as far as the numbered questions.

14. Ask a student to clap the erasers over the cold hot plate. Have the students describe the motion of the dust.

15. Turn on the hot plate. While it is heating, go over the Caution on page 247 with the students.

16. Ask a student to clap the erasers above the heated hot plate. Then turn off the hot plate.

17. Discuss the italicized questions in column 2.

18. Discuss the numbered questions with the students. You may wish to have the students take turns going over to the chalkboard to diagram the systems that they tested.

DESIRED LEARNING OUTCOME: The students should be able to describe evidence of convection currents in air.

****

DEVELOPMENT: Lesson Cluster 4A-1 Conduction and Convection
Page T-416/S-248 Convection Liquids (30 min.)

PURPOSE: To extend the concept of convection currents in liquids.

ADVANCE PREPARATION: Materials
- 4 jars, glass, identical 946 ml (32 oz.)
- food coloring, red, blue, or green
- 2 file cards
- felt-tip pen, black

Language Cards/Key Signs
convection currents
liquids

Identification Cards

TEACHING SUGGESTIONS:

1. Ask the students to turn to page 248.

2. Introduce the lesson by explaining to the students that in this lesson they are going to observe convection currents in liquids instead of in air.

3. Have the students read through page 248 to find out about the experiments that you are going to do for them. Teacher may paraphrase.

4. Gather the students around the table where you have set up the materials.

5. Add ten drops of food coloring to one of the jars of cold water. Place a wet file card over the jar of uncolored cold water and invert it over the jar of colored water. Ask a student to pull out the card.

6. Have the students observe and discuss the mixing that takes place for five minutes. Then set the jars aside..

7. Add ten drops of food coloring to the jar of hot water. Place a wet file card over the jar of uncolored, cool water and invert it over the jar of colored water. Ask a student to pull out the card.

8. Have the students observe and discuss the mixing that occurs for five minutes.

9. Discuss the numbered questions with the students. Help them to understand that the movement of food coloring in water is evidence of convection currents. Emphasize that energy can be transferred through moving matter.

DESIRED LEARNING OUTCOME: The students should be able to describe evidence of convection currents in water.

****

APPLICATION: Lesson Cluster 4A-1 Conduction and Convection
Page T-417/S-249 Room Air Currents (30 min.)

PURPOSE: To apply energy transfer by convection to the circulation of air in a room.

ADVANCE PREPARATION: Materials
- paper and pencil for each student
- paper spirals from "Paper Spirals" page T-226
- string
- scissors
- thumbtacks

Language Cards/Key Signs
convection currents
air currents
heat energy
predict

Identification Cards

Cut five pieces of string of varying lengths from 30 cm to 60 cm (1 ft. to 2 ft.). Make a small hole in the top of each spiral and poke one of the strings through it. Knot the end of the string. Loop the other end of the string around a thumbtack. Letter the paper spirals from "A" through "E." Make the letters large enough so that they can be read from a distance. Locate places around the classroom where the spirals may later be hung so that they can turn freely.

TEACHING SUGGESTIONS:

1. Have the students read the first column on page 249 as far as the next to last paragraph to find out how they are going to use paper spirals to determine whether or not there are convection currents in the classroom.

2. Tell the students where the spirals will be hung. Also show them the paper spirals that you have lettered.

3. Make a chart on the chalkboard. Write the headings "Where Hung" and "Predicted Motion" across the top. Write the letters "A" through "E" down the left side. Have the students give you brief phrases that describe where each spiral will be hung to fill in the first column of the chart. Then ask them to predict the motion of each spiral. Record their predictions on the chart.

4. Distribute the paper and pencils. Remind the students to record only the letters on the spirals that turn and the direction in which they turn on their papers.

5. Hang up the paper spirals. Provide time for the students to observe the spirals and record their observations.

6. Discuss the italicized questions in the first column on page 249 with the students. Record whether their predictions were right or wrong on the chart.

7. Be sure the students understand that a turning spiral is evidence of convection currents.

8. Have the students do the rest of page 249.

9. Discuss how air travels in the classroom and the questions in the second column on page 249. Help the students to understand that warm air rises.

DESIRED LEARNING OUTCOME: The students should be able to describe the circulation of of air in the classroom in terms of convection currents.

****

EVALUATION: Lesson Cluster 4A-1 Conduction and Convection
Page T-418/S-250 Energy Movements (35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Distinguighing between conductors and insulators.
2. Identifying the energy giver, energy receiver, and conductor in a conduction system.
3. Indicating the relative motion of a convection current.
4. Indicating the direction of movement in a convection current.

TEACHING SUGGESTIONS:

1. Have the students turn to page 250 and read through the lesson. Teacher may paraphrase.

2. Have the students proceed with the lesson when you are certain that they understand what they are to do.

3. Go over the responses with the students when they have completed their work. You may wish to let the students ocrrect their own papers.

4. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of each question, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 4 Matter and Energy

Part A Transfer of Energy, Lesson Cluster 4A-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-424	Introduction	Water Waves	40 min.
T-426	Introduction	Making Waves With Rope	35 min.
T-427	Development	Reflected Waves	35 min.
T-425	Enrichment	More Reflected Waves	35 min.
T-428	Development	Crossing Waves	35 min.
T-429	Development	Wave Shapes	40 min.
T-430	Application	Wave Speed	45 min.
T-431	Evaluation	Waves	40 min.

NOTE: Enrichment lesson is not optional.

B. MATERIALS: See materials list on page T-421.

INTRODUCTION: Lesson Cluster 4A-2 Wave Motion
Page T-424/S-251 Water Waves (40 min.)

PURPOSE: To introduce the concept that waves are disturbances that travel through matter that does not travel.

ADVANCE PREPARATION: Background Information - When a file card is put into one end of a container of water, the water where the card enters is disturbed. Energy is necessary to produce the disturbance. The disturbance sets up waves that travel throughout the container of water. The waves, or disturbance travels; the water does not. This can be demonstrated by floating a piece of paper on the surface of the water. The paper tends to move up and down but it does not travel across the surface of the water. The student may have the impression that water moves in the direction of a wave from watching waves breaking on a shore. However, in shallow water at a shore, there is not enough water to fill out the wave forms, so the waves break up. In deep water, waves move forward in a vertical oval, but the water does not travel forward. Knowledge of waves is valuable to science. The study of light, color, lasers, radio, television, and radar all are based on that knowledge.

Materials - Each group of 3 students will need:
- water supply
- 1 clear plastic container, 8 cm. x 17 cm.x 4 cm. (3 3/16 in. x 6 3/16 in. x 1 5/8 in.)
- 1 index card
- 1 sheet of white paper, 21.5 cm x 28 cm (8 1/2 in. x 11 in.)
- scissors
- pencil
- 1 metric ruler
- 1 2.5 cm x 2.5 cm (1 in. x 1 in.) square of white paper

Language Cards/Key Signs
water waves
waves
wave motion
disturbance
energy
matter

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that they are first going to investigate water waves. Ask the students to describe waves they have seen in lakes or in the ocean.

2. Teacher should paraphrase the introductory paragraph.

3. Divide the class into groups of three.

4. Have the students read page 251 to find out how they are going to experiment with water waves. Teacher may paraphrase the directions and demonstrate the procedure if necessary.

5. Emphasize with the students that before they do each part of the experiment they should be sure that the surface of the water is smooth and undisturbed.

6. Have the students begin to work. Remind them to answer all the questions.

7. Discuss the questions with the students. Help them to understand that it is the waves that move forward, not the body of water.

DESIRED LEARNING OUTCOME: The students should be able to describe waves as disturbances that can travel through water that does not travel.

****

INTRODUCTION: Lesson Cluster 4A-2 Wave Motion
Page T-426/S-252 Making Waves With Rope (35 min.)

PURPOSE: To reinforce the concept that waves are disturbances that travel through matter that does not travel.

ADVANCE PREPARATION: Materials - 1 clothesline or other rope, 3m (10 ft.)
- 3 pieces of ribbon or yarn, 30 cm (1 ft.) each

Language Cards/Key Signs
waves
energy
solid

Identification Cards

606

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that waves can travel through solids such as rope as well as through liquids.

2. Have the students read page 252 to find out how they are going to investigate the travel of waves through rope. Teacher may paraphrase.

3. Ask students to tie the three pieces of ribbon or yarn on the rope equal distances apart. Have another student tie one end of the rope to a doorknob or other steady object.

4. Have the students gather around the rope so that they all can easily see it. Caution them to observe both the ribbons tied to the rope as sell as the rope itself.

5. Ask a student to move the free end of the rope up and down as many times as necessary for the students to complete their observations.

6. Discuss the italicized questions with the students. Then discuss the numbered questions.

DESIRED LEARNING OUTCOME: The students should be able to describe waves as disturbances that can travel along a length of rope that does not travel.

****

DEVELOPMENT: Lesson Cluster 4A-2 Wave Motion
Page T-427/S-253 Reflected Waves (35 min.)

PURPOSE: To extend the investigation of waves to reflected waves.

ADVANCE PREPARATION: Materials - Each group of 3 students will need:
- water supply
- 1 clear plastic container (same as first lesson)
- 1 file card
- 1 metric ruler

Language Cards/Key Signs
reflected waves
properties

Identification Cards

TEACHING SUGGESTIONS:

1. Explain to the students that they are going to investigate reflected waves.

2. Have the students read the two introductory paragraphs on page 253 to find out what reflected waves are. Teacher may paraphrase.

3. Have the students read the rest of page 253 to find out how they are going to investigate reflected waves.

4. Divide the class into groups of three.

5. Have the students do the lesson and answer the questions. Remind the students to use the pictures on page 253 to help them with the experiments. If necessary, the teacher should do his or her own experiment along with the students as a demonstration.

607

6. Have the students discuss the italicized questions and compare their observations.

7. Discuss the numbered questions with the students. Help the students to relate each decrease in wave size to the loss of some energy each time the wave bounced off the wall of the container. In discussing question 3, help the students to understand that each wall of the container can be an energy giver or receiver depending on the direction of the wave's motion.

DESIRED LEARNING OUTCOME: The students should be able to describe some properties of reflected waves.

****

ENRICHMENT: Lesson Cluster 4A-2 Wave Motion
Page T-425 More Reflected Waves (35 min.)

PURPOSE: To provide a more challenging activity involving reflected waves for students who need or can deal with such tasks or for the whole class. This lesson does not appear in the student text.

ADVANCE PREPARATION: Materials - Each group of 3 students will need:
- 1 file card
- 1 clear plastic container (as in previous lesson)
- water supply
- 1 bar of paraffin wax, 8 cm x 4 cm x 1 cm (3½ in. x 1 5/8 in. x 3/8 in.)

Language Cards/Key Signs
Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by having the students review their observations from (2) Reflected Waves.

2. Draw a diagram on the chalkboard of a rectangular wave container. Draw an arrow on it to indicate the direction of a wave traveling from one end to the other.

3. Ask a student to draw another arrow to show the direction in which the wave would be reflected off the end of the container. (The second arrow should point in the opposite direction.)

4. Point out to the class that the end of the container from which the wave is reflected is straight or at a right angle to the direction in which the wave moves.

5. Draw another diagram of a rectangular wave container beside the first one. Draw a barrier near the end of the container in this diagram that is at an angle to the end of the container. (See Figure 4-1.)

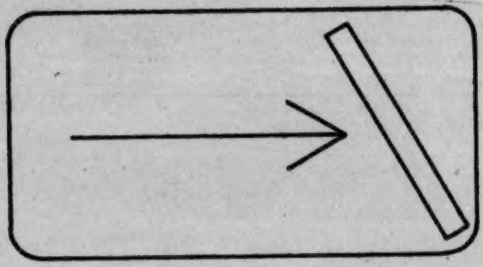


Figure 4-1. Wave Tank and Barrier.

6. Ask the students to predict the direction in which a wave would be reflected from the straight barrier placed at an angle in relation to an incoming wave. Have a student go to the board and draw an arrow on the diagram to show the predicted direction.

7. Tell the students that they are going to check their prediction using the wave-making system used in (2) Reflected Waves. Have them look at picture A on page 253 to help them recall the system.

8. Show the students how to place a paraffin barrier in a container so thatit is at an angle to the wave's direction of movement. Use Figure 4-1 as a model.

9. Divide the class into groups of three if the whole class is going to do the experiment. If only a few students have been assigned to do it, tell them whether they are to work individually or in pairs.

10. Suggest that they place the barrier in three or more different positions to check their predictions.

11. Discuss the students' observations after everyone has completed the experiment. If their results prove that they had incorrectly predicted the direction of the reflected wave, ask a student to correct the arrows that were previously drawn on the chalkboard diagram.

DESIRED LEARNING OUTCOME: The students should be able to demonstrate that a wave reflected off a straight barrier placed at an angle travels in a different direction from the incoming wave.

****

DEVELOPMENT: Lesson Cluster 4A-2 Wave Motion
Page T-428/S-254 Crossing Waves (35 min.)

PURPOSE: To extend the investigation of waves to the crossing of waves.

ADVANCE PREPARATION: Materials - Each group of 3 students will need:
- water supply
- 1 clear plastic containers as in previous lessons

Language Cards/Key Signs
waves
crossing waves
reflected waves

Identification Cards

Before class, practice the process of generating crossing waves so that you can help the students during the activity. The container can more easily be controlled by using your free hand to steady the container's corner of contact with the surface on which it is placed.

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing with the students how many waves traveled across the container when they observed reflected waves in the last lesson. (One wave repeatedly corssed the container until it disappeared.)

2. Explain to the students that in this lesson they are going to learn about crossing waves.

3. Ask the students to read page 254 to find out how they are going to investigate crossing waves. Teacher may paraphrase.

4. Demonstrate for the students, using an empty container how they can use their free hand to steady the corner of the container in contact with their desk.

5. Divide the class into groups of three.

6. Have pairs of students go a few at a time to the supply table to get their materials.

7. Have the students begin to work and answer the questions.

8. Circulate among the students providing help as it is needed.

9. Discuss the questions with the students. Help them to understand that streams of water are moving matter, but waves are disturbances that travel through matter. Crossing streams of water combine to form one stream, but corssing waves pass through each other and continue on their way.

DESIRED LEARNING OUTCOME: The students should be able to describe some properities of crossing waves.

****

DEVELOPMENT: Lesson Cluster 4A-2 Wave Motion
Page T-429/S-255 Wave Shapes (40 min.)

PURPOSE: To extend the investigation of waves to wave shape.

ADVANCE PREPARATION: Materials - Each group of 3 students will need:
- water supply
- 1 plastic container as in previous lesson
- 1 metric ruler
- 1 round container such as a bucket
- 1 medicine dropper

Language Cards/Key Signs
wave shapes
round
square
reflected waves

Identification Cards

Background Information: The shapes of waves created in a container are independent of the shape of the container. The nature of the energy giver determines the shape only when they begin at the center of the container's water surface. Reflections of circular waves from the walls of circular containers are curved, but not circular, when they begin at a location other than the center of the container's water surface. This difference in the ways that circular containers is subtle. You may wish to include a special investigation and explanation of it when the students discuss the numbered questions on page 255. Using a larger round container may help to make the differences in initial and reflected waves more apparent.

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that in this lesson they are going to investigate the shapes of waves.

2. Divide the students into groups of three.

3. Ask the students to read page 255 to find out what they are going to do. Call their attention to the picture making sure that they know how to add the drop of water to the round container and later, to the straight-sided container.

4. Have the groups go a few at a time to the supply table to get their materials.

5. Have the students begin to work and to answer the questions. Remind the students first to predict the shape of the waves in the straight-sided container and then to test their predictions.

6. Discuss the italicized questions with the students. Have them compare the outcomes of their predictions.

7. Discuss the numbered questions with the students.

DESIRED LEARNING OUTCOME: The students should be able to describe some differences in initial and reflected wave shapes.

****

APPLICATION: Lesson Cluster 4A-2 Wave Motion
Page T-430/S-256 Wave Speed (45 min.)

PURPOSE: To introduce the property of wave speed.

PREREQUISITE: Ability to measure in cm.

ADVANCE PREPARATION: Materials - Each group of 3 students will need:
- water supply
- clear plastic container as in previous lesson
- 1 metric ruler

Language Cards/Key Signs
wave speed
predict

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they are going to find out about the speed of waves.

2. Have the students turn to page 256 to find out how they are going to investigate wave speed. Teacher may paraphrase.

3. Divide the class into groups of three.

4. Have the groups go a few at a time to the supply table to get their materials and then begin to work.

5. Circulate among the groups providing help as it is needed. Have only students who have difficulty distinguishing between the speed of waves in water of differing depths use two containers side-by-side for their comparisons. You may want to combine one or two groups for such a comparison.

6. Remind the students to predict wave speed in water that is 0.5 cm deep before they do that experiment.

7. Discuss the italicized questions with the students.

8. Discuss question 1 with the students. Write "fastest wave," "in-between wave," and "slowest wave" on the chalkboard. Have students go to the board and write the depth of the water in which waves of the described speeds occurred.

9. Discuss question 2 with the students. Help the students to understand that waves slow up as they approach the shore because of the decreasing depth of the water. The faster waves overtake the slower waves and combine with them to form higher waves that reach the shore.

DESIRED LEARNING OUTCOME: The students should be able to demonstrate that wave speed is less in shallow water than it is in deeper water.

****

EVALUATION: Lesson Cluster 4A-2 Wave Motion
Page T-431/S-257 Waves (40 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Determining that the wave form, not the water, travels in a wave-making system.
2. Naming the energy givers and receivers in a wave-making system.
3. Naming some properties of reflected waves.
4. Explaining that an increase in the depth of shallow water will increase the speed of waves.

TEACHING SUGGESTIONS:

1. Have the students turn to page 257 and read through the lesson. Teacher may paraphrase.

2. Have the students proceed with the lesson when you are certain that they understand what they are to do.

3. Go over the responses with the students when they have completed their work. If you wish, let the students ocrrect their own papers so that they may evaluate their own progress.

4. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

5. For further informal evaluation, have the students turn back to page 242 and look at the picture that introduces Part A. Ask them why they think that particular picture was used to introduce the part that they have just completed. Suggest that they look for clues in the part title and in the cluster title on page 243. The students should be able to:
   a. determine that energy is being transferred between the batteries of the two cars by conduction.
   b. identify the wire connecting the two batteries in the cars as a conductor of electricity.

****

Level 5 Unit 4 Matter and Energy

Part B Changes in Matter, Lesson Cluster 4B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-438	Introduction	Moving Objects	25 min.
T-440	Development	Energy of Motion	45 min.
T-442	Development	Moving Matter	45 min.
T-444	Development	Moving a Paper Dragon	35 min.
T-445	Application	Energy Chains	35 min.
T-446	Enrichment	Marble Chains	40 min.
T-447	Evaluation	Motion and Energy	35 min.

NOTE: Enrichment lesson in this cluster is optional.

B. Materials: Add the following to the Materials List on page T-435:
-several paper dragons - see lesson Moving a Paper Dragon T-444
-1 football

INTRODUCTION: Lesson Cluster 4B-1 Changes in Motion
Page T-438/S-259 Moving Objects (25 min.)

PURPOSE: To review or introduce motion as evidence of energy transfer.

ADVANCE PREPARATION:

Background Information - Energy is necessary to produce a change. Because energy is transferred during change, c ahcnge in an object is evidence of energy transfer. Such a change as the motion of an object is evidence of energy transfer.

Materials - none.

Language Cards/Key Signs
energy
energy transfer
energy giver
energy receiver

TEACHING SUGGESTIONS:

1. Introduce Part B by having the students read the title of the part and look at the picture that introduces it on page 258.

2. Introduce the first cluster by explaining to the students that they will first review or learn about changes in the motion of matter. Students who have done the unit FORCES at this level will probably remember learning that a change in the movement of an object can result from energy transfer and that an object that gains energy may move.

3. Have the students read and answer the questions on page 259. Teacher may paraphrase.

4. Discuss the italicized questions with the students. Ask the students what the paper spiral and sailboat have in common when energy is transferred to them. (They both move.)

5. Discuss the numbered questions with the students. Extend the discussion by asking the students what they think the energy giver is in the basketball system described in question 2. They will probably be able to figure out that the basketball's motion implies that someone threw the ball.

DESIRED LEARNING OUTCOME: The students should be able to describe the motion of an object as evidence of energy transfer.

****

DEVELOPMENT: Lesson Cluster 4B-1 Changes in Motion
Page T-440/S-260 Energy of Motion (45 min.)

PURPOSE: To review or introduce the concept of energy of motion.

PREREQUISITES: Ability to measure in cm.

ADVANCE PREPARATION:

Background Information - Energy is required to move objects. For example, when a bowler rolls a bowling ball down an alley, the bowler's muscles (energy giver) transfer energy to the bowling ball (energy receiver). As the ball strikes the pins, energy is transferred from the ball (energy giver) to the pins (energy receiver). The energy that the ball possesses as it moves down the alley is called energy of motion. All moving objects possess energy of motion.

Language Cards/Key Signs
energy of motion
inclined plane
distance
speed

Materials - Each pair of students will need:
-4 books
-1 marble, small, 1 cm (3/8 in.) in diameter
-1 marble, large, 2 cm (3/4 in.) in diameter
-4 paper, unlined, 23 cm x 3 cm (9 in. x 12 in.)
-2 metric rulers
-2 pencils

TEACHING SUGGESTIONS:

1. Introduce the lesson by having the students read the first two paragraphs on page 260 to review the term energy of motion or to find out what the term means. Students who have done the third level unit INTERACTION AND ENERGY will probably remember learning that when objects move, they have motion energy. Teacher may paraphrase.

2. Be sure that the students understand the term.

3. Divide the class into groups of two.

4. Tell the students that they are going to investigate how the energy of a moving object changes when its speed changes.

5. Have the students read page 260 to find what they are going to do. Teacher may paraphrase.

6. Discuss the directions for the experiment using the picture on page 260.

7. Distribute four books, one small marble, and a piece of paper.

8. Have the students begin to work.

9. Circulate among the groups providing help as it is needed. If necessary do the activity along with the students for demonstration.

10. Discuss the italicized question on page 260 with the students.

11. Have the students read page 261 to find out what they are going to do in the second part of the lesson. Teacher may paraphrase.

12. Distribute the rulers, paper, and pencils to the groups and have one student in each group copy the chart on page 261.

13. Discuss the directions for the experiment using the picture on page 261.

14. Ask the students to predict from which position on the inclined plane the smaller marble will cause the larger marble to move the greater distance. Write their prediction on the chalkboard.

15. Distribute the large marbles and have the students begin to work. Remind them to answer all the questions.

16. Circulate among the groups providing help in setting up materials or in measuring distances as it is needed.

17. Discuss all the questions with the students. Have the students determine whether or not their prediction that is written on the board was correct. Check the students' understanding of the lesson by asking them whether a car has more energy of motion traveling at 55 km/h or at 25 km/h. (55 km/h)

DESIRED LEARNING OUTCOME: The students should be able to demonstrate that an object's change in energy of motion is based on its change in speed.

****

DEVELOPMENT: Lesson Cluster 4B-1 Changes In Motion
Page T-442/S-262 Moving Matter (45 min.)

PURPOSE: To extend the concept of energy of motion to clooiding systems in which the amount of matter in the energy receiver varies.

PREREQUISITES: Ability to measure in cm.

ADVANCE PREPARATION:

Background Information - Objects with more matter move shorter distances than objects with less matter when they collide with objects having the same energy of motion.

Materials - Each pair of students will need:
- inclined plane system from previous lesson
- 2 metric rulers
- pencils and paper
- 1 vial with cap
- 1 paper cup
- enough salt or sand to nearly fill the vial

Language Cards/Key Signs
- vial
- energy
- matter
- distance
- solid
- evidence

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that in this lesson they are going to learn more about energy of motion in colliding objects.

2. Divide the class into groups of two.

3. Have the students read page 262 and answer the questions. Teacher may paraphrase.

4. Discuss the questions with the students. Be sure the students understand that the height of sand in a vial would increase as the amount of sand increases.

5. Distribute the paper, the pencils, and the rulers and have each student copy the chart on page 262.

6. Have the students read page 263 to find out about the experiment they are going to do.

7. Discuss the directions with the students using the pictures on page 263.

8. Distribute three books, one marble, one vial, and a cup of sand and begin to work.

9. Circulate among the groups providing help as it is needed. Suggest to the students that they bend one edge of the rim of their paper cups to form a spout. This will make it easier for them to pour sand into the vials. If necessary, do the activity with the students for demonstration.

10. Have the students answer the numbered questions when they complete the experiment.

11. Discuss the numbered questions with the students. In discussing question 2, list the responses of the students on the chalkboard. Then have the class develop a general rule through a discussion of the listed responses. Write the agreed-upon rule on the chalkboard and leave it there so that the students may refer to it in the next lesson.

DESIRED LEARNING OUTCOME: The students should be able to demonstrate that an object with more matter moves a shorter distance than an object with less matter when it collides with an object having the same energy of motion. They should also be able to infer that more energy is required to move an object consisting of more matter than one consisting of less matter.

****

DEVELOPMENT: Lesson Cluster 4B-1 Changes In Motion
Page T-444/S-264 Moving A Paper Dragon (35 min.)

PURPOSE: To provide further practice with colliding systems in which the amount of matter in the energy receiver varies.

ADVANCE PREPARATION: Materials
-reproduction of chart on board
-several paper dragons
-paper clips
- several marbles

Language Cards/Key Signs
energy giver
energy receiver
matter
variables
evidence

TEACHING SUGGESTIONS:

1. Introduce the lesson by having the students read the first column on page 264 through the italicized questions. Teacher may paraphrase.

2. Have the students turn back to the picture on page 145 of "A Paper Dragon" to help them identify the energy giver and energy receiver in the paper dragon system that they made in Unit 2, FORCES.

3. Ask the students to read the rest of the lesson and answer the questions. Suggest that they use the picture on page 146 of "Changing the Paper Dragon" to help them. Also remind them to reread the general rule on the chalkboard that they stated in the last lesson about how the energy needed to move an object depends on the amount of matter in the object.

4. If some students are having difficulty conceptualizing the paper dragon activity let them use the materials to actually do the activity described.

5. Discuss all the questions with the students. In the discussion of question 1, ask the students to give evidence from the chart to support their answers. In discussing question 2, ask the students if they think the general rule on the chalkboard explains the energy needed to move increasing amounts of matter in "paper dragons" as well as in vials. Again ask the students to base their responses on evidence given in the chart. If the students are not satisfied with the rule on the board, provide an opportunity for them to revise it.

DESIRED LEARNING OUTCOME: The students should be able to demonstrate that an object with more matter moves a shorter distance than an object with less matter when it collides with an object having the same energy of motion. They should also be able to infer that more energy is required to move an object consisting of more matter than one consisting of less matter.

****

APPLICATION: Lesson Cluster 4B-1 Changes In Motion
Page T-445/S-265 Energy Chains (45 min.)

PURPOSE: To apply the concept of energy transfer to energy chains.

ADVANCE PREPARATION:

Background Information - A series of two or more energy transfers within a system is called an energy chain. Energy chains may be represented by diagrams in which key words and arrows are used. Using this technique, the energy transfers that occur when a bowler knocks down pins with a bowling ball would be diagrammed as follows:

Language Cards/Key Signs
energy chains
energy transfer
diagram

Bowler's muscle $\xrightarrow{\text{energy transfer}}$ bowling ball
$\xrightarrow{\text{energy transfer}}$ bowling pins

Materials -paper and pencil for each student
-several marbles
-football

TEACHING SUGGESTIONS:

1. Have the students read page 265 as far as the numbered questions to review or to find out how to diagram energy chains. Use the materials to demonstrate the energy chains described. Ask the students if they can think of any other energy chains. When possible have them demonstrate the chain. Students who have done the third level unit INTERACTION AND ENERGY will probably remember drawing energy chains using pictures and arrows to show energy moved. Those who have done the fourth level unit EXPLORING ENERGY will probably remember drawing energy chains using words and arrows to show energy transfers.

2. Discuss the italicized questions with the students. Stress that there must be a series of two or more energy transfers in a system to form an energy chain.

3. Distribute the paper and pencils and ask the students to respond to the numbered questions.

4. Have the students share their energy-chain diagrams and descriptions of energy chains. You may wish to have some students put theirs on the board.

DESIRED LEARNING OUTCOME: The students should be able to diagram an energy chain and to describe the energy transfers in an energy chain.

****

ENRICHMENT (optional): Lesson Cluster 4B-1 Changes in Motion
Page T-446 Marble Chains (40 min.)

PURPOSE: To provide work involving energy chains for students we need or can handle more challenging tasks.

ADVANCE PREPARATION: Materials - Each student or pair of students will need:
-3 books
-1 small and 2 large marbles
-paper and pencil

Language Cards/Key Signs
predictions
marble chains
diagram
energy chain
motion

TEACHING SUGGESTIONS:

1. Introduce the lesson by having the students turn back to the picture on page 261 of Energy of Motion to review the inclined plane system that they used earlier.

2. Ask the students what they think would happen if another large marble were placed in the gutter so that it touched the one already there and then a small marble were released from the top of the plane. If necessary set up the experiment (but don't do it) to help make it more clear for the students. Ask them to predict the motion of each of the two large marbles. Write the predictions on the chalkboard.

3. Tell the students that they are going to test their predictions. When they have completed the test, they are to draw a diagram of the energy chain in the system and write a description that explains what the energy chain shows.

4. Have each student or group of students get three books, one small marble, two large marbles, a piece of paper, and a pencil and then begin to work. Remind the students that the large marbles must be in contact.

5. Discuss the experiment with the students. Have them determine whether or not their predictions on the chalkboard were correct. The students should have observed that the large marble struck by the smaller marble remained stationary, but the other large marble moved.

6. Ask a student to draw his or her diagram of the energy chain on the chalkboard. The diagram should resemble this one:

   small marble $\xrightarrow{\text{energy transfer}}$ large marble struck

   $\xrightarrow{\text{energy transfer}}$ second large marble

7. Ask the students why they think that the first large marble remained stationary when it was struck by the smaller marble. Help them to understand that the smaller marble's energy of motion was transferred through the first large marble to the second large marble.

8. Ask the students to predict the motion of each of three large marbles placed at the bottom of the inclined plane after a smaller marble is released from the top. Have one of the students test the predictions that are made while the others observe. (Only the large marble that is farthest away from the one struck moves.)

DESIRED LEARNING OUTCOME: The students should be able to determine which objects in a collision system will move and draw a diagram to represent the energy transfers that take place in the system.

****

EVALUATION: Lesson Cluster 4B-1 Changes in Motion
Page T-447/S-266 Motion and Energy (35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Determining the relative distances that struck objects will travel based on inference of their speeds and observation of the amounts of matter in them.
2. Identifying energy givers and energy receivers in collision systems.
3. Drawing diagrams of energy chains.

TEACHING SUGGESTIONS:

1. Have the students turn to page 266 and read through the lesson. Teacher may paraphrase.

2. Have the students proceed through the lesson when you are certain that they understand what they are to do.

3. Go over the responses with the students when they have completed their work. If you wish, let the students correct their own papers so that they may evaluate their own progress.

4. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of each questions, you may assume that he or she has demonstrated the objectives for the cluster, and is ready to go on to the next cluster.

****

Level 5 Unit 4 Matter and Energy

Part B Changes in Matter, Lesson Cluster 4B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-452	Introduction	Transforming Energy	30 min.
T-453	Development	Motion and Temperature	30 min.
T-454	Development	Energy and Friction	30 min.
T-456	Development	Heat Changes Matter	45 min.
T-458	Development	Heating A Solid	35 min.
T-459	Development	Cooking Food	25 min.
T-460	Application	The Greatest Energy Giver	30 min.
T-461	Evaluation	Energy and Temperature	35 min.

B. MATERIALS: Add the following to the materials list on page T-449:
-1 hot plate
-paper spiral
-shuffleboard stick and disk or something similar for lesson on T-454

INTRODUCTION: Lesson Cluster 4B-2 Changes in Motion
Page T-452/S-267 Transforming Energy (30 min.)

PURPOSE: To review or introduce the concept of energy transformation.

ADVANCE PREPARATION:

Background Information - When energy trnasfers through a system, it may be transformed or changed from one form to another form. Energy transformation may occur once or more than once in an energy chain. Energy transfer, however, may occur without the transformation of energy.

Language Cards/Key Signs
energy
transform
energy chain
electric
temperature

Materials - 1 hot plate
- 1 paper spiral

TEACHING SUGGESTIONS:

1. Introduce the cluster by telling the students that in this cluster they are going to study changes in temperature, another kind of change that occurs in matter.

2. Introduce the lesson by asking the students to name all the forms of energy that they have studied. Write the forms that they name on the chalkboard. Their list should include: heat, electricity, light, motion. Leave the list on the board for use later in the lesson.

3. Explain to the students that energy can be transformed during energy transfer.

4. Have the students read the two introductory paragraphs on page 267 to review or find out what happens when energy is transformed.

5. Be sure that the students understand what energy transformation is. Those who have done the fourth level unit EXPLORING ENERGY will probably remember learning about energy transformation and drawing energy chains in which energy transformation occurred.

6. Distribute the paper and pencils. Then ask the students to read the rest of page 267 and answer all the questions. Suggest to them that they refer to the list of forms of energy on the board when they make up an example of energy transformation. Use the materials to demonstrate the energy chain described in the lesson.

7. Discuss the italicized question with the students. Help them to distinguish between energy transformation and energy transfer. Point out that motion energy is transferred, not trnasformed, at the end of the diagram.

8. Ask several students to draw their energy chain diagrams on the chalkboard. Have the other students distinguish between the energy transfers and transformations.

DESIRED LEARNING OUTCOME: The students should be able to diagram and describe energy transformation in energy chains.

****

DEVELOPMENT: Lesson Cluster 4B-2 Changes In Motion
Page T-453/S-268 Motion and Temperature (30 min.)

PURPOSE: To extend the study of energy transformation to the trnasformation of the energy of motion into heat energy.

ADVANCE PREPARATION: Materials - Each student will need:
-paper and pencil
-1 jumbo paper clip
Also have 2 books on hand.

Language Cards/Key Signs
energy
motion
evidence
energy transfer
temperature

TEACHING SUGGESTIONS:

1. Introduce the lesson by rubbing two books together. Ask the students, "What happens to the energy of motion that I transferred to the books by rubbing them together?" Draw an energy chain diagram on the chalkboard to help them respond:

   Hands or muscles and hands ⟶ motion ⟶ books ⟶ ?

2. Have the students give their ideas about what happens to the energy of motion that you transferred. List their ideas at the end of the energy chain diagram on the chalkboard. Leave the diagram on the board for use later in the lesson.

3. Have the students read through page 268 to find out how they are going to test whether or not energy of motion is transformed in two different systems. Teacher may paraphrase.

4. Discuss the directions for the experiments with the students. Use the pictures on page 268 to be sure that they understand how to bend and use the paper clips. Caution the students against hurting their lips with the sharp ends of the paper clips.

5. Distribute the paper clips, paper, and pencils and have the students begin to work. Remind them to answer all the questions.

6. Discuss the italicized questions with the students. Then refer them to the energy chain diagram on the chalkboard and the list of their ideas about what happened to the energy of motion transferred to the books. The students should be able to determine that the energy of motion would be transformed to heat energy. Have them try the experiment if they are not sure of this outcome.

7. Discuss the numbered questions with the students. Have several students put their energy chain diagrams on the chalkboard as part of the discussion of questions 2.

DESIRED LEARNING OUTCOME: The students should be able to demonstrate that energy of motion can be transformed into heat energy.

****

DEVELOPMENT: Lesson Cluster 4B-2 Changes in Motion
Page T-454/S-269 Energy and Friction (30 min.)

PURPOSE: To reintroduce the concept of friction and relate it to the transformation of the energy of motion to heat energy.

ADVANCE PREPARATION:

Background Information - Friction is a force not a form of energy. The existence of friction can be inferred when an object stops moving and its energy of motion is transformed into heat energy.

Materials - Each student will need:
-1 book, paper and pencil
Also have on hand:
-shuffleboard, stick and disc or something similar

Language Cards/Key Signs
energy
friction
force
motion
transform
heat

TEACHING SUGGESTIONS:

1. Have the students read the first three paragraphs on page 269 to review the term friction. Be sure that they understand that friction is a force, not a form of energy. The students will probably remember studying friction in Unit 2, FORCES. If they need further review have them reread page 135 of that unit.

2. Distribute the books, paper, and pencils. Explain that they are to use the books to check their answers after they have responded to the questions in column 1.

3. Have the students read the rest of page 269 as far as the numbered questions

and answer all the italicized questions. Teacher may paraphrase. Use the materials to demonstrate the shuffleboard game.

4. Discuss the italicized questions with the students. Help the students to understand that friction caused both the book and the wooden disk to stop moving, and that the energy of motion of both the book and disc is transformed into heat energy by friction.

5. Discuss question 1 with the class. Have several students draw the shuffleboard diagram on the chalkboard. You may wish to have others diagram the hand-book system.

6. Discuss question 2 with the students. Have them describe as many examples of friction acting on a moving object as they can. List the examples on the chalkboard. Then have the students explain what happens to the energy of motion of the object in each example.

DESIRED LEARNING OUTCOME: The students should be able of identify situations in which energy of motion can be transformed into heat energy by friction.

****

DEVELOPMENT: Lesson Cluster 4B-2 Changes In Motion
Page T-456/S-270 Heat Changes Matter (45 min.)

PURPOSE: To extend the study of temperature changes in matter to the expansion and contraction of objects caused by gain or loss of heat.

ADVANCE PREPARATION:

Background Information - Matter usually expands when it is heated and contracts when it is cooled. In this lesson, unmarked thermometer tubes containing colored alcohol are used to show this. Because the volume of the tubes remains constant, the students are able to relate the expansion (rise) and contraction (fall) of the red fluid within the tubes to a gain or a loss of heat energy.

Language Cards/Key Signs
heat
matter
temperature
expand
contract
heat energy
thermometer

Materials - Each pair of students will need:
- -2 thermometer tubes, unmarked
- -3 containers clear, 237 ml (8 oz.)
- -access to a clock or watch with second hand

Fill one large container with water and let it stand overnight or for a few hours so that it will be at room temperature in time for class. Just before class, fill the second large container with cold water and the third large container with hot water. Cover the hot water container so that the heat does not escape. Then fill 1 small container for each pair of students with water at room temperature and 1 with hot water. If unmarked thermometers are unavailable, you may use marked thermometers. If there is a clock with a second hand in the classroom, you do not have to collect clocks or other timers.

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to describe some ways in which heat energy changes matter. They will probably describe such changes as cooked food, melted ice, and boiled water.

2. Explain to the students that in this lesson they are going to learn about another way in which heat energy can change matter.

3. Have the students read the first two paragraphs on page 270.

4. Make sure that the students understand the meanings of the terms expand and contract.

5. Divide the class into groups of two.

6. Have the students read the rest of page 270 to find out about the first experiment they are going to do. Teacher may paraphrase.

7. Go over the Caution on page 270 with the students. Stress the importance of exercising care in handling hot liquids at home as well as in science class.

8. Have each group get a container of water at room temperature, and an unmarked thermometer tube.

9. Distribute a container of hot water to each group, as well as a clock or other timing device if there isn't a clock with a second hand in the classroom.

10. Have the students begin to work. Remind them to answer the italicized questions when they complete the experiment.

11. Discuss the italicized questions on page 270 with the students.

12. Have the students read page 271 through the italicized questions to find out what they are going to do in the second experiment. Teacher may paraphrase.

13. Have one member of each group get a container of cold water. Then have the students begin to work.

14. Ask the groups to return their materials and then complete the rest of the lesson on page 271 when they finish the experiment.

15. Discuss the italicized questions on page 271 with the students. Also discuss how the flight of a hot-air balloon depends on the expansion of heated air. Explain to the students that there is a burner attached to real hot-air balloons that heats the air in the bottom of the balloon and causes the air to expand.

16. Discuss the numbered questions with the students. Help them to understand that heat energy transfers from warmer objects to cooler objects.

DESIRED LEARNING OUTCOME: The students should be able to describe the expansion and contraction of liquids and gases in terms of a gain or loss of heat energy.

****

DEVELOPMENT: Lesson Cluster 4B-2 Changes In Motion
Page T-458/S-272 Heating A Solid (35 min.)

PURPOSE: To extend the study of the expansion and contraction of matter to solids.

ADVANCE PREPARATION: Materials - optional - reproduction of the picture on T-458 on board or transparency. Include a third picture showing the wire after being heated. The washer should be closer to the desk.

Language Cards/Key Signs
expand
contract
solids
gain
loss

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that in this lesson they are going to find out whether a gain or loss of heat energy causes solids to expand or contract.

2. Have the students read page 272 and answer all the questions. Teacher may paraphrase. If necessary use the board illustrations to help the students understand the experiment.

3. Discuss the italicized questions with the students when they have completed their work. Have them describe all the ways that they thought of to find out if solids change in size when they gain or lose heat energy. List the ways that they describe on the chalkboard.

4. Ask the students, by a show of hands, how many knew that the wire expanded when it was heated before they read the paragraph above the numbered questions. Also ask them how they knew that the smaller measurement of cm after the wire was heated meant that the wire had expanded. (The wire drooped closer to the table when it expanded.)

5. Discuss the numbered questions with the students. Help the students to understand that the expansion of contraction of a wire is evidence of heat energy transfer and that some solids expand when they are heated and contract when they are cooled.

DESIRED LEARNING OUTCOME: The students should be able to infer that some solids will expand when they are heated and contract when they are cooled.

* * *

DEVELOPMENT: Lesson Cluster 4B-2 Changes In Motion
Page T-459/S-273 Cooking Food (25 min.)

PURPOSE: To extend the study of changes in matter caused by heat energy to changes in food caused by cooking.

ADVANCE PREPARATION: Materials - paper and pencil for each student

Language Cards/Key Signs
properties matter
energy chains

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that evidence of heat energy transfer can be observed in cooked food.

2. Distribute the paper and pencils to the students. Explain to them that the paper is for the diagrams that represent energy chains called for in the text.

3. Have the students read page 273, answer all the questions, and draw diagrams to represent the energy chains. Teacher may paraphrase.

4. Discuss the italicized questions with the students. Have a student draw his or her energy-chain diagram representing the boiling of eggs on the chalkboard. Ask other students to draw energy chain diagrams on the board to represent the frying, scrambling, and poaching of eggs. Ask the rest of the class to describe the energy transformation that takes place in each energy chain.

5. Discuss the numbered questions with the students. Have the students share their energy-chain diagrams of the cooked food that they like by putting them on the chalkboard.

6. Ask the students to describe changes in food that can be caused by cooling. The students will probably describe the hardening of food when it is frozen or the solidification of liquid gelatin when it is placed in the refrigerator.

DESIRED LEARNING OUTCOME: The students should be able to describe some changes in food caused by heat energy transfer.

****

APPLICATION: Lesson Cluster 4B-2 Changes in Motion
Page T-460/S-274 The Greatest Energy Giver (30 min.)

PURPOSE: To apply what has been learned about energy chains to food chains.

ADVANCE PREPARATION: Materials - paper and pencil for each student

Language Cards/Key Signs
energy
solar energy
temperature

Background Information - Either directly or indirectly the sun is the source of most of Earth's energy. Green plants can use energy directly from the sun to make food. We get our energy indirectly from the sun by eating plants or animals that have eaten plants. Petroleum, natural gas, and coal form from plants that used energy directly from the sun. We indirectly use the sun's energy stored in the fuels. It is said that most of Earth's energy comes from the sun because neither nuclear nor geothermal energy can be traced back to the sun as their source.

TEACHING SUGGESTIONS:

1. Have the students read page 274 as far as the numbered questions. Teacher may paraphrase.

2. Be sure the students understand that the sun is the source of most of the energy used on Earth.

3. Discuss the energy chain diagram with the class. Students who have done the third level unit POPULATION INTERACTIONS will probably remember learning about eating interactions that make up a kind of energy chain called a food chain. The time needed for discussion at this time will depend on how familiar the students are with this concept.

4. Have the students answer the numbered questions.

5. Ask a student to draw his or her diagram that represents the sun-horse energy chain on the board. Have the class discuss any differences between their diagrams and the one on the board. Correct the diagram on the board if necessary.

6. List on the chalkboard all the ways the students use solar energy. Help them to understand that they indirectly use the sun's energy stored in foods and in fuels. If the students wonder why the sun does not supply all the energy used on Earth, you may wish to share with them the explanation given in Background Information.

DESIRED LEARNING OUTCOME: The students should be able to identify the sun as the initial energy giver in most food chains.

****

EVALUATION: Lesson Cluster 4B-2 Changes in Motion
Page T-461/S-275 Energy and Temperature (35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Inferring that energy of motion can be transformed into heat energy.
2. Explaining that some solids will expand when heated and contract when cooled.
3. Identifying the sun as the initial energy giver in nearly all energy chains.

ADVANCE PREPARATION: In addition to paper, pencil and text, each student will need: 1 rubber band, any size

TEACHING SUGGESTIONS:

1. Have the students turn to page 275 and read through the lesson. Teacher may paraphrase.

2. Demonstrate for the class how to pull a rubber band back and forth rapidly and then hold it in a stretched position against the lips. Exphasize that the rubber band should not be pulled to a full stretch when pulling it back and forth. It could break and hurt someone.

3. Distribute the materials and have the students proceed with the lesson when you are certain that they understand what they are to do.

4. Collect the rubber bands and go over the responses with the students when

they have completed their work. If you wish, let students correct their own papers so that they may evaluate their own progress.

5. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

****

Level 5 Unit 4 Transfer of Energy

Part B Changes In Matter, Lesson Cluster 4B-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-466	Introduction	Liquid-Gas Phase Change	35 min.
T-468	Development	Solid-Liquid Phase Change	35 min.
T-472	Enrichment*	Everyday Phase Changes	50 min.
T-469	Application	Volcanoes	45 min.
T-470	Evaluation	Changing Phase	40 min.

NOTE: Enrichment lesson is not optional.

B. MATERIALS: Add the following to the Materials List on page T-463:
-1 teakettle
-pan of water
-candle and matches
-media about volcanoes - National Geographic, Jan. 1981 issue

APPLICATION: Lesson Cluster 4B-3 Changes In Phases
Page T-469 /S-279 Volcanoes (35 min.)

PURPOSE: To apply energy transfer during phase change to volcanoes.

ADVANCE PREPARATION: Materials - media about volcanoes-National Geographic, Jan. 1981 has excellent pictures of Mt. St. Helens
- paper and pencils

Language Cards/Key Signs
volcano
liquid
phase
lava
solid

TEACHING SUGGESTIONS:

1. Use media to introduce or review volcanoes.

2. Explain to the students that in this lesson they are going to learn about phase changes and energy transfers in volcanoes.

3. Have the students read page 279 and answer all the questions. Teacher may paraphrase.

4. Discuss the italicized questions with the students. Help them to understand that when hot, liquid lava changes to a solid on the Earth's surface, it loses heat energy. When solid rock inside the Earth gains heat energy, it changes to a liquid.

5. Ask a student to draw his or her diagram of the lava-rock energy chain on the chalkboard. Ask other students to add to the energy chain if they can.

6. Point out to the students where you have placed the reference books on volcanoes. Tell them that they may use them during their free time. If you plan to have all or some students do reports, models or pictures, assign them at this time. Provide time during a later class for them to share their reports and projects.

DESIRED LEARNING OUTCOME: The students should be able to describe the solid-liquid phase changes of lava and the energy transfers that accompany the changes.

****

INTRODUCTION: Lesson Cluster 4B-3 Changes In Phases
Page T-466/S-276 Liquid-Gas Phase Change (35 min.)

PURPOSE: To review phase changes and to identify such changes in matter as evidence of energy transfer.

ADVANCE PREPARATION:

Language Cards/Key Signs
phase change
matter
solid
liquid
gas
energy transfer
energy giver
energy receiver

Background Information - When water is boiled in a pan on an electric range, the heating element on the range, the energy giver, transfers heat energy to the pan, the energy receiver. The pan then becomes an energy giver, transferring heat to the water in the pan, the energy receiver. The water, having gained heat energy, boils and changes from a liquid to a gas. The change in phase is evidence that energy has been transferred. If a cold object is held directly above the steaming pot, heat energy from the steam, the energy giver will be transferred to the object, the energy receiver. The steam loses heat energy and changes from a gas to a liquid. The change in phase is evidence of energy transfer. Further evidence of change in phase can be observed when poisture forms on the outside of a glass of ice-cold liquid. Heat energy from warm air, the energy giver, is lost when it comes in contact with the cold glass, the energy receiver.

Materials -rubbing alcohol
-plastic vial with cap
-medicine dropper
-4 paper towels
-hot plate
-tea kettle or pan of water
-pancake turner

The medicine dropper and rubbing alcohol are available at drug stores. Although you will probably have to purchase 473 ml (1 pt.), the smallest size in which it is sold, you can sace what you do not use for next year. Fill the vial with alcohol and cap it. Cut the paper towels into 10 cm x 10 xm (4 in. x 4 in.) pieces. Find out if any student is allergic to rubbing alcohol before putting alcohol on his or her hand.

TEACHING SUGGESTIONS:

1. Introduce the cluster by having the students read its title on page 276. Review the three phases, or forms, of matter. Students who have done the fourth level unit EXPLORING MATTER will probably remember learning that matter may be in the form of a solid, a liquid, or a gas. Those who have done the fourth level unit PATTERNS will probably remember that matter changes phases in the water cycle.

2. Introduce the lesson by explaining to the students that they are going to relate what they have learned about matter and energy to phase changes.

3. Have the students read page 276 to find out what they are going to do. Teacher may paraphrase.

4. Discuss the Caution with the students. Stress that they are to keep their hands at a distance from their lips when they blow on the alcohol.

5. Then put a few drops of alcohol from the vial on the back of one hand of each student.

6. Provide time for the students to observe the alcohol and think about the italicized questions that end at the top of column 2.

7. Distribute the pieces of paper towel and then put a few drops of alcohol on each piece.

8. Provide time for the students to observe the alcohol and think about the italicized questions.

9. Discuss all the italicized questions with the students. Help the students to relate the disappearance of the alcohol to a change in phase from liquid to gas - evidence that heat energy transferred from the warm air surrounding the alcohol to the alcohol. The alcohol that gained energy changed to a gas.

10. Have the students throw away the paper towels and wash their hands.

11. Have the students read page 277 and answer all the questions. Demonstrate the tea kettle experiment for the class.

12. Discuss the questions with the students. Help the students to relate the water droplets that formed on the pancake turner and the pitcher of lemonade to a change in phase from gas to liquid - evidence that heat energy transferred from the water vapor in the air when it came in contact with the cold pitcher. The water vapor that lost energy changes from a gas to a liquid.

DESIRED LEARNING OUTCOME: The students should be able to identify phase changes as evidence of energy transfer and describe energy transfers that take place in liquid-gas changes.

****

DEVELOPMENT: Lesson Cluster 4B-3 Changes In Phases
Page T-468/S-278 Solid-Liquid Phase Change (35 min.)

PURPOSE: To extend the study of energy transfer in phase changes to solids and liquids.

ADVANCE PREPARATION: Materials - Each student will need:
-1 ice cube
-plastic container, 237 ml
Also have a candle and matches on hand.

Language Cards/Key Signs
solid
liquid
phase change
energy transfer

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that in this lesson they are going to learn about energy transfer in solid-liquid phase changes.

2. Have the students read page 278 through the italicized questions above picture A. Teacher may paraphrase.

3. Caution the students against holding the ice cubes for very long. Explain that they could injure their hands.

4. Distribute the materials and have the students begin to work.

5. Discuss the italicized questions with the students. Help them to relate the water in the containers to a change in phase from a solid to a liquid - evidence that heat energy transferred from their hands to the ice cube.

6. Have the students read the last paragraph in column 1. Demonstrate the candle experiment. Then discuss the italicized questions with them. Help the students to relate the dripping wax to a change in phase from a liquid to a solid. The candle gained heat energy causing it to change from a solid to a liquid. The liquid wax changed to a solid when it lost heat energy to the air.

7. Distribute the paper and pencils and have the students draw the diagram described in question 1.

8. Use questions 2 and 3 to review energy transfers in solid-liquid phase changes.

DESIRED LEARNING OUTCOME: The students should be able to identify phase changes as evidence of energy transfer, describe energy transfers that take place in solid-liquid phase changes, and infer that energy is needed to change a solid to a liquid.

****

ENRICHMENT: Lesson Cluster 4B-3 Changes In Phase
Page T-472 Everyday Phase Changes (50 min.)

PURPOSE: To provide additional practice in describing energy transfers in phase changes. This lesson does not appear in the student text. It should be done following (2) Solid-Liquid Phase Changes.

ADVANCE PREPARATION: Materials - none.

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that in this lesson they are going to analyze some phase changes that can be observed in everyday life.

2. Make a chart in the chalkboard. Write the headings "Solid to Liquid," "Liquid to Gas," "Gas to Liquid," and "Liquid to Solid" across the top.

3. Ask the students to describe phase changes that they have observed at school, at home, and outdoors. As each change is described, have the class tell you under which heading on the board it should be listed. The students will probably describe such changes as: the melting of ice cream, snow, ice, and heated margarine; the evaporation of water from puddles, sidewalks, and their hands when they do not thoroughly dry them; the condensation of water on a glass of ice water and of water vapor when it rains; the solidification of melted butter, melted ice cream, and liquid pudding.

4. Record each change on the chart in words such as "water vapor to rain."

5. Ask each student to pick one phase-change description on the board and decide which is the energy receiver. Then ask them to decide whether energy is gained or lost in during the phase change. Provide time for the students to do this.

6. Put a plus sign before each phase change in which energy is gained and a minus sign before each change in which energy is lost.

7. Ask the students to study the chart for a pattern. They will probably observe that energy is gained when a solid changes to a liquid and when a liquid changes to a solid.

DESIRED LEARNING OUTCOME: The students should be able to determine that energy is gained when a solid changes to a liquid and when a liquid changes to a gas and that energy is lost when a gas changes to a liquid and when a liquid changes to a solid.

****

EVALUATION: Lesson Cluster 4B-3 Changes In Phase
Page T-470/S-280 Changing Phase (40 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Identifying phase changes.
2. Identifying energy givers and receivers in phase changes.

TEACHING SUGGESTIONS:

1. Have the students read through pages 280 and 281. Teacher may paraphrase.

2. Have the students proceed with the lesson when you are certain that they understand what they are to do.

3. Go over the responses with the students when they have completed their work.

If you wish, let the students correct their own papers so that they may evaluate their progress.

4. Collect the papers so that you can evaluate each individual's progress. If a student correctly identifies all or most of the phase changes and the energy givers and receivers involved, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

5. For further informal evaluation, have the students turn back to page 258 and look at the picture that introduces Part B. Ask them why they think that particular picture was used to introduce the part they just completed. Suggest that they look for clues in the part title and in the cluster titles on page 267 and 276. The students should be able to:
   a. identify the sun as the initial energy giver in the picture.
   b. infer that heat energy and light energy from the sun were transferred directly to the green plants.
   c. infer that the energy the bird obtained indirectly from the sun in its food was transformed into sound energy.
   d. identify the solid to liquid phase change of the snow and ice.
   e. identify the phase change of the snow and ice as evidence of energy transfer.
   f. infer that the snow and ice gained energy when they changed from solid to liquid.

* * *

Level 5 Unit 4 Matter and Energy

Part C _Changes in Systems_, Lesson Cluster 4C-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-478	Introduction	Interactions and Systems	30 min.
T-479	Development	A System for Circulating Blood	30 min.
T-480	Development	A Bicycle-Moving System	30 min.
T-481	Enrichment*	Systems Everywhere	50 min.
T-482	Development	Still the Same System?	45 min.
T-484	Application	Comparing Systems	35 min.
T-485	Evaluation	Know Your Systems	30 min.

NOTE: Enrichment lesson is _optional_.

B. MATERIALS: Add the following to the Materials List on page T-475:
-1 bicycle as pictured on page 285
-1 hand saw and piece of wood or tree limb (optional) see Evaluation Lesson

INTRODUCTION: Lesson Cluster 4C-1 _Systems, Matter and Change_
Page T-478/S-283 _Interactions and Systems_ (30 min.)

PURPOSE: To reintroduce the concepts of interaction and system and relate them to energy transfer and energy chains.

ADVANCE PREPARATION:

Background Information - The term system is used to designate a specific group of related, interacting objects. The concept of system is important because it can enable the students to isolate particular objects, to keep track of a group of objects during an interaction, to infer relationships among interacting objects, and to begin to look for cause and effect relationships in interactions.

Language Cards/Key Signs
interaction
system
interact
change

Materials - paper and pencils

TEACHING SUGGESTIONS:

1. Introduce Part C of the unit by having the students read the title of the part and look at the picture on page 282. Explain to the students that in the previous part they learned about changes in matter. In this part they are going to learn about changes in systems.

2. Have the students read the two introductory paragraphs to the lesson on page 283 to review the terms interaction and system. Teacher may paraphrase.

3. Make certain that the students understand the concepts by writing on the chalkboard "Did interaction take place?" Most students will probably agree that interaction took place. Ask the students on what evidence they based their answer (words on the chalkboard) and what objects interacted (hand, chalk, and chalkboard). You may wish to return to the review of the concepts and the term evidence on page T-146 of Unit 2 FORCES.

4. Have the students complete the first column.

5. Let the students discuss their answers to the questions.

6. Have the students answer the numbered questions. Demonstrate the action of writing a letter to help make the system more clear. Review, if necessary, how to draw a diagram of an energy chain in Energy Chains on page 265.

7. Have the students compare and discuss their diagrams and descriptions of a letter-writing system.

DESIRED LEARNING OUTCOME: The students should be able to describe interacting objects in a system and draw a diagram of an energy chain that represents interactions with two or more energy transfers.

* * *

DEVELOPMENT: Lesson Cluster 4C-1 Systems, Matter and Change
Page T-479/S-284 A System for Circulating Blood (30 min.)

PURPOSE: To reintroduce structures of the body that make up systems. You may want to correlate this lesson with a health lesson or use it in place of one.

ADVANCE PREPARATION:

Background Information - The functions of the circulatory system are to transport nutrients and oxygen to every portion of the body and to remove waste products from every portion. Each interacting structure or organ has specific functions relative to the other structures in the system.

Materials - none

Language Cards/Key Signs
system
interact
circulatory system
heart
veins
arteries
blood
capillaries

TEACHING SUGGESTIONS:

1. Introduce the lesson by reminding the students that in Unit 1, ADAPTATION, they learned that some inside structures in organisms interact and that some interacting structures make up systems. Organisms may have several inside systems that do something to help the organisms stay alive.

2. Tell them that they are going to learn about the human circulatory system.

3. Have the students read and answer the questions on page 284. Teacher may paraphrase. Help the students see some of their own veins and arteries.

4. Have the students discuss their answers to the questions. In naming the main

parts of the human circulatory system, ask the students to explain, in terms of function, why each structure should be included in the system. Also ask them to explain how the structures in the circulatory system are related. (They help to carry nutrients and oxygen in the blood to each part of the body and to carry away waste from each part.)

5. Review with the students the skeletal, respiratory, digestive, and muscular systems in organisms that they have previously studied. You may wish to have them turn back to pages 25-33 in Lesson Cluster B-1 of ADAPTATIONS if they have difficulty in remembering the structures in any or all of these systems.

DESIRED LEARNING OUTCOME: The students should be able to name the main structures in the human circulatory system and to describe how the structures are related by function.

* * *

DEVELOPMENT: Lesson Cluster 4C-1 Systems, Matter and Change
Page T-480/S-285 A Bicycle-Moving System (30 min.)

PURPOSE: To provide practice in naming objects in a system and in describing the relationship of the interacting objects in that system.

ADVANCE PREPARATION: Materials -1 bicycle as on page S-285
-paper and pencils

Language Cards/Key Signs
bicycle
interact
drive system

TEACHING SUGGESTIONS:

1. Have the students read the first column on page 285 and answer the italicized questions at the top of the second column. Teacher may paraphrase. Use the bicycle to help the students see the drive system more clearly.

2. Ask the students to name the structures in the bicycle-moving system. If the students disagree about which objects should be included in the system, have them determine whether of not the structure is related to the other structures that make the bicycle move.

3. Have the students draw the diagram described in the first numbered question. Review with them, if necessary, how to make a diagram that shows the energy transfers in a system. You may wish to have the students turn back to Transforming Energy on page 267 to look at the examples of diagrams that are given in that lesson.

4. Have the students compare and discuss the diagrams that they made.

5. Discuss questions 2 and 3 with the students.

6. Extend the lesson, if you wish, by having the students describe and diagram the steering system, the stopping system, and the lighting system of a bicycle.

DESIRED LEARNING OUTCOME: The students should be able to name the objects in a bicycle-moving system and make a diagram of the system that shows the energy transfers in it.

* * *

ENRICHMENT (optional): Lesson Cluster 4C-1 Systems, Matter and Change
Page T-481 Systems Everywhere (50 min.)

PURPOSE: To provide additional practice in identifying objects in a system and describing how they are related by interaction or function. This lesson does not appear in the student text. It should be done following (3) A Bicycle-Moving System.

Language Cards/Key Signs
system

ADVANCE PREPARATION:

Background Information - The term system is in common use today. In newspapers, weekly news magazines, and on television, references are made to school systems, to computer systems, to communication systems, and to electronic systems. Some advertisements indicate openings for the position of systems analyst in various companies; other advertisements indicate special prices to check the cooling systems of automobiles. Most students will probably by aware of many of these uses of the term systems.

Materials - Each group of 3 students will need:
- -1 sheet of unlined paper
- -pencil
- -3 sheets of colored paper
- -3 scissors
- -glue
- -crayons
- -paper or cardboard for labels

In this lesson, the students will either draw or cut out objects that interact to form systems with which they are familiar. By working in groups, the students will be able to share their ideas and the work involved in representing various systems. The students may be encouraged to make more complicated systems than they would if they worked individually. The students will need a variety of reference books, magazines, or other materials to research objects in systems about which they are not sure. Ask a librarian to help you find books or other materials written for elementary students that contain information about the parts in a computer system and such automobile systems as the lubrication, cooling, transmission, exhaust, or carburetor systems. Ask also for books dealing with systems in plants, telephone, telegraph, and television systems, weather systems, and electrical systems in homes. Place the books that you collect with the other materials on a centrally-located supply table.

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they are going to draw or cut out pictures of objects that can interact to form systems and that they will work in groups.

2. Divide the class into groups of three.

3. Distribute the unlined paper and pencils.

4. Ask each group to list some systems with which they are familiar. Suggest that they think about systems in their town, at school, and at home.

5. Compile a list on the chalkboard of all the systems that the groups named. Supplement the list, as necessary, with such systems as the town's school system, a food-shopping system, a kitchen system, a school-work system, and other systems about which you have been able to gather reference books. Be sure that the list contains some simple systems as well as some that are more complex. Do not feel that you personally must be able to name the objects in every system that the students name.

6. Explain to the students that each group is to choose a system and then list the objects in that system. Point out the reference materials that they may use to help them. Further explain that the members in each group may either draw, color, and then cut out the objects or cut out parts of objects from colored paper and then paste them together.

7. Have the groups choose a system, list the objects in it, and then go to the supply table to get their materials.

8. Circulate among the groups providing help as it is needed.

9. Have the members of each group tell the rest of the class about the system that they made. Ask them to name the objects in the system as they hold them up. Then ask them to tell how the objects are related by interaction or function.

10. Make a bulletin board display of the students' systems. Have the groups write the names of the systems they made on pieces of paper. Place the names beside the appropriate systems on the bulletin board. The display can be used as a handy reference theoughout the rest of the cluster.

11. Conclude the lesson by stressing that system is a common and important term in today's vocabulary.

DESIRED LEARNING OUTCOME: The students should be able to name the objects in a system of their own choosing and describe the relationship of the objects in the system.

****

DEVELOPMENT: Lesson Cluster 4C-1 Systems, Matter and Change
Page T-482/S-286 Still the Same System? (45 min.)

PURPOSE: To extend the concept of system to changed systems in which matter may or may not be gained or lost.

ADVANCE PREPARATION:
Background Information - The term system is used to designate a specific group of objects that have interacted, are interacting, or could interact. Unless matter is gained or lost within a system, the system can undergo a series of changes and still remain the same system. Energy can be transferred among the objects within the system or transferred in or out of the system and it still remains the same system. However, if matter is gained or lost, the original system loses its identity and becomes a new system.

Language Cards/Key Signs
system
interacting
evidence
battery
wire
bulb

Materials -Each pair of students will need:
-1 battery, flashlight, size D, 1.5 V
-1 bulb, flashlight, size 13
-1 jumbo paper clip
-wire, aluminim, uninsulated, 20 gauge, 30 cm (12 in.)
-masking tape

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that systems can undergo many changes and still remain the same system. Ask them under what conditions they think that the original system would lose its identity and become a new system. Accept the students' opinions because it is more important at this time for them to become aware of the problem than to answer correctly.

2. Tell the students that the lesson they are about to do will help them to answer the question more definitely.

3. Divide the class into pairs.

4. Have the students read through the lesson to find out what they are going to do. Teacher may paraphrase.

5. Discuss pictures A and B with the students to make sure that they understand how to put together the electric systems. Students who have done the unit EXPLORING ENERGY will probably remember how to connect an electric system with tape.

6. Tell the students that each pair will need one battery, one bulb, one piece of wire, a paper clip, and a strip of tape 5 cm (2 in.) long. You may wish to put the list on the board to help the students remember what they need.

7. Suggest to the students that they stick one end of the tape to the edge of their desks so that they may snip off pieces as they need them to connect their electric systems.

8. Have the students get their materials and begin to work.

9. Circulate among the students providing help as it is needed. Encourage the students to take turns holding the parts of the electric systems and applying the tape.

10. Discuss the italicized questions with the students.

11. Check the students understanding of the lesson by making a chart on the chalkboard and having them tell you how to fill it. Write the headings "Original System A," "System B," and "System C" across the top. Write "Added or Removed" and "Same or Different System" and "How Different" down the side. The students should understand that energy was added to Original System A, the battery was removed from System B, and a paper clip was added to System C. They should also understand that System A is the same system even if energy transferred through it. System B is a new system because an object (matter) was removed from it, System C is a new system because an object (matter) was made of one of more different kinds of matter.

12. Discuss the numbered questions with the students. Refer to the chart on the

board if the students have difficulty. Be sure they understand that when matter is removed (the battery) or added (the paper clip) to a system, a new system is formed. Interaction in a system (the bulb lighting) does not determine whether or not a new system is formed. The formation of a new system depends on the gain or loss of matter.

DESIRED LEARNING OUTCOME: The students should be able to infer from their observations of electric systems that when objects (matter) are added to or removed from a system, a new system is formed.

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APPLICATION: Lesson Cluster 4C-1 Systems, Matter and Change
Page T-484/S-287 Comparing Systems (35 min.)

PURPOSE: To apply what has been learned about the gain oe loss of matter in changes systems to pictured evidence of changes in systems.

ADVANCE PREPARATION: Materials - none

Language Cards/Key Signs
systems
interact
evidence

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing with the students under what conditions a system loses its identity and becomes a new system (when there is a gain or loss of matter in the system). Also review under what conditions a system is transferred in the system: when the objects interact; when there is no gain or loss of matter.

2. Have the students read page 287 and answer all the italicized questions. Teacher may paraphrase.

3. Have the students discuss the italicized questions. Ask them to describe the evidence in the pictures on which they based their answers. The students will probably not have difficulty in determining that no matter has been gained or lost in the paper-cutting system so the system remains the same. Based on their experiments with batteries and bulbs in the last lesson, they will probably have no difficulty in determining that the addition of matter (the second battery) to the battery - bulb system results in the formation of a new system. The cold-drink system may, however, cause the students some difficulty. Help them, if necessary, by asking them what happens to carbonated drinks after the drinks have been standing for awhile. (They become "flat" after the gas has escaped). Help the students to understand that the bubbles lost from the cold-drink system are matter in the form of a gas so the system lost matter and became a new system. You may want to have the students turn back to page 276 to review Liquid-Gas Phase Changes.

4. Provide time for the students to read and think about question 1. Then ask several students to state the general rule that they have decided on. Write the rules on the chalkboard in the words of the students. Then have the class decide which rule will work whenever they have to decide whether or not systems have changed into different systems or let them make up a different rule.

DESIRED LEARNING OUTCOME: The students should be able to generalize that if matter is gained or lost in a system, the original system becomes a new system.

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EVALUATION: Lesson Cluster 4C-1 Systems, Matter and Change
Page T-485/S-288 Know Your Systems (30 min.)

PURPOSE: To evaluate the students' preformance in relation to the following objectives:

1. Losting the objects in a system.
2. Drawing a diagram to represent the energy transfers in an interacting system.
3. Determining whether an original system remains or a new system is formed after changes in the system.
4. Describing the basis for deciding whether a new system is formed after changes in the system.

ADVANCE PREPARATION: Materials - In addition to paper, pencil and text, have on hand:
- 1 hand saw and piece of wood or tree limb; see Teacher Suggestions.

TEACHING SUGGESTIONS:

1. Have the students turn to page 288 and read the lesson. Teacher may paraphrase.

2. Have the students do the lesson when you are sure that they understand what they are to do. If necessary demonstrate use of a saw to help students visualize the system described in first question.

3. Go over their responses with the students when they have completed their work. If you wish, let the students correct their own papers so that they may evaluate their own progress.

4. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to all or most of each question, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Part C Changes in Systems, Lesson Cluster 4C-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-490	Introduction	Acid and Bases	30 min.
T-491	Development	Indicators	50 min.
T-493	Development	Testing Some Acids and Bases	50 min.
T-497	Enrichment	Testing With Litmus	50 min.
T-496	Development	Other Indicators	30 min.
T-498	Application	A Breath Test	40 min.
T-499	Evaluation	Using Indicators	40 min.

NOTE: Enrichment Lesson is not optional.

B. MATERIALS: Add the following to the materials list on page T-487:
-lemon
-baking soda
-Milk of Magnesia

INTRODUCTION: Lesson Cluster 4C-2 Changes in Acids and Bases
Page T-490/S-289 Acids and Bases (35 min.)

PURPOSE: To introduce terms acid and base.

PREREQUISITES: Ability to identify common properties.

Language Cards/Key Signs
matter
acid
base
common properties
bitter
sour

ADVANCE PREPARATION:

Background Information - Matter that has properties of acids or bases can be found in many foods. Taste properties of acids and bases can be detected in some foods because of the interaction of the foods with taste receptors in the mouth. The typical sour taste of acids observed in orange, lemon, and tomato juice, cream of tartar, and vinegar is due to their high acid content. The typical bitter taste of baking powder, baking soda, and unsweetened chocolate is due to the presence of bases.

Such cleaners as those used for bricks or concrete have properties of acids. Household ammonia, washing soda, dishwater detergents, and dry drain cleaners have properties of bases.

Materials -lemon
-baking soda
-Milk of Magnesia
-any other edible that is either sour or bitter

TEACHING SUGGESTIONS:

1. Ask the students to read the introductory paragraph on page 289 to find out what acids and bases are. Teacher may paraphrase.

2. Be sure the students understand that acids, as well as bases, have properties in common.

3. Have the students read the rest of page 269 and answer the questions. Teacher may paraphrase. Let the students taste the materials so they better understand the properties of sour and bitter.

4. Discuss the questions with the students. Be sure to emphasize that they should never taste anything unless they are sure it is safe, and not poisonous or harmful.

5. Discuss with the students their past experiences with acids and bases. Most will probably be aware of the characteristic slippery feel of such bases as soap and household cleaners. Some students may have observed leaky batteries that corroded the metal in a toy or a flashlight. Explain to them that acids characteristically corrode may metals.

DESIRED LEARNING OUTCOME: The students should be able to relate the sour and bitter tastes of some familiar foods to the common taste properties of the acids or bases.

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DEVELOPMENT: Lesson Cluster 4C-2 Changes in Acids and Bases
Page T-491/S-290 Indicators (50 min.)

PURPOSE: To introduce the use of bromthymol blue (BTB) as a chemical indicator that may be used to detect the presence of acids and bases in matter.

ADVANCE PREPARATION:

Background Information - The detection of acids and bases is difficult when they are in low concentration in matter. Low concentrations of acids and bases may, however, be detected by their interaction with other matter called indicators. Indicators are chemicals that show one color when placed in an acid and another color when placed in a base.

Language Cards/Key Signs
indicator
acid
base
properties

Red cabbage, beet, cherry, and grape juice are all natural indicators. The indicator that is used in this cluster is the chemical bromthymol (BTB) which is blue in bases or in matter containing a base, yellow in acids or in matter containing acid, and green when the matter is neutral.

Materials -bromthymol blue (BTB) solution
-measuring container, 250 mL
-vials or pill bottles with caps, plastic, transparent
-vinegar, 473 mL (16 oz.)
-dishwashing liquid, 273 mL (16 oz.)
-3 large containers, 946 mL (32 oz.)
-crayon, black
Each pair of students will need:
-3 containers, wide mouth, plastic, small 250 mL (8 oz.)
-1 drinking straw, plastic or medicine dropper
-tray, such as frozen food pans

ADVANCE PREPARATION:

Bromthymol blue (BTB), the indicator used in this and in two later lessons, may be purchased inexpensively at pet supply stores or from scientific supply houses. Be sure the kind you buy has a water base rather than an alcohol base. Because the indicator is used again in (3a) Testing Some Acids and Bases, on page T-493 and in (5) A Breath Test, on page T-498, purchase a 237 mL (8 oz.) bottle of BTB now so that you will have enough to yse in those lessons, also. The amounts suggested will provide you with enough dilute BTB solution for the three lessons in this cluster. The unused portion of BTB in the bottle may be saved for next year.

In one large container, prepare a dilute solution of BTB by adding 35 drops of BTB to 946 mL (32 oz.) of water. The solution should be neutral and appear green. If the solution is blue, add vinegar drop by drop until it turns green. If the solution is yellow, add liquid soap drop by drop until it turns green. Variation in mineral content of the water may make it difficult to maintain the green BTB solution. If you have such difficulty, prepare 946 mL (32 oz.) of blue BTB and 946 mL of yellow BTB solution. Then have the students test the X and Y solutions in both the blue and yellow BTB solutions. For your own safety, be sure you wash your hands after you handle the BTB.

Collect the vials or pill bottles and place them on a centrally-located supply table. Fill each vial half full of BTB solution. Cap each vial as you fill it so that the BTB will not interact with air. Prepare a control vial that the students may use for color comparison. Cap the vial and set it aside so that it will not get mixed up with the vials of BTB that the students use.

In the second large container, add 236 mL (8 oz.) of vinegar to 708 mL (24 oz.) of water. Mark 15 of the smaller containers with an X using the black crayon. Then fill each one half full of vinegar solution.

In the third large container, add two tablespoons of dishwashing liquid to 946 mL (32 oz.) of water. Mark the other 15 smaller containers with a black Y. Then fill each one half full of soap solution.

Place one vial of BTB, one container each of the X and Y liquids, one empty container, and a straw on each of the trays.

TEACHING SUGGESTIONS:

1. Have the students read the introductory paragraph on page 290 to find out what an indicator is. Teacher may paraphrase.

2. Explain, when they have finished, that there are many kinds of indicators that scientists use. Write the term bromthymol blue on the chalkboard and tell the students that this is the long chemical name of the indicator that they are going to use. It is called BTB for short. Students who have done the fourth-level unit ENVIRONMENTS will probably remember using BTB as a blue liquid indicator to determine whether or not mealworms, sprouted bean seeds, and people change the air factor in their environment.

3. Divide the class into groups of two.

4. Have the students read through the rest of page 290 to find out how they are going to test for acids and bases using BTB. Teacher may paraphrase and demonstrate procedure.

5. Write the term neutral on the chalkboard. Hold up a vial of BTB and explain that each pair of students will use a vial of neutral green BTB that you have prepared. It is neutral because it does not show the properties of either an

acid or a base.

6. Hold up one container marked X and one marked Y. Explain that these are the X and Y liquids that each pair of students will test.

7. Go over the Caution on page 290. Emphasize with the students that they should keep their hands away from their faces when they work with BTB. Tell them that after they have completed the lesson they will all have an opportunity to wash their hands.

8. Demonstrate for the students how to use a straw as a dropper. Using only a container of vinegar, show them how to put the straw into the liquid, place the finger over the top of the straw, hold the finger on the straw when withdrawing it from the liquid, and how to move the finger up and down on top of the straw to release the liquid drop by drop. Students who have done the fourth-level unit EXPLORING MATTER will probably remember using this technique to make liquid lenses.

9. Distribute a tray of materials to each pair.

10. Have the students begin to work.

11. Circulate among the students providing help as it is needed. Although some students may be able to identify the liquids by their odors, avoid telling them at this time what the two liquids are. Instead, emphasize the observation of color changes that the liquids cause in the BTB solution. Be sure that the students are adding the liquids a drop at a time.

12. Have the students return their trays of materials to the supply table.

13. Have all the students wash their hands.

14. Discuss all the questions with the students. Let the students share their findings. Generally, they will find that the liquid that smells like vinegar will cause BTB to turn yellow and the liquid that smells like soap will cause BTB to change to blue. The students' results may vary because of the different amounts of acid or base that they mixed with the BTB.

15. Help the students to understand that the color change in BTB depends on how much of a liquid is added to BTB as well as on which of the two liquids is added.

16. Tell the students that liquid X is vinegar, and acid. When acids interact with BTB it changes to yellow. Also tell them that liquid Y is dishwashing liquid, a base. When bases interact with BTB it changes to blue. Point out that bases and blue begin with the same letter. This can help them to remember.

17. Pour the BTB left in the vials down a sink. Be sure to let the water run hard while you are doing this. Then be sure to wash your hands. Also pour the vinegar and soap solutions down the sink. Thoroughly wash the vials and containers and place them where they will be ready for use in the next lesson.

DESIRED LEARNING OUTCOME: The students should be able to demonstrate that an acid changes the indicator BTB to yellow and a base changes it to blue.

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648

DEVELOPMENT: Lesson Cluster 4C-2 Changes in Acids and Bases
Page T-493/S-291 Testing Some Acids and Bases (50 min.)

PURPOSE: To use BTB to test for the presence of acids or bases in common household substances.

Language Cards/Key Signs
acids
bases
indicators
neutral

ADVANCE PREPARATION: Materials - Each pair of students will need:

- -3 vials or pill bottles as in previous lesson
- -1 drinking straw or medicine dropper
- -1 tray
- -unlined paper and pencil
- -ruler, any

Also have on hand:

- -BTB
- -1 large container, 946 mL (32 oz.)
- -black crayon
- -liquids that show properties of an acid, such as orange, tomato, and lemon juice *
- -solids that show properties of an acid such as baking sida, baking powder *

*See student text page 291 for more suggestions

Put small amounts of each solid and liquid in vials so that each pair of students has one of each kind. Write on each vial what material it contains. The students will need the information for their charts. Fill 15 clean vials half full of the BTB solution that you prepared for (2) Indicators. Place a vial of BTB, a vial of acid, a vial of base, and a straw on each of the trays.

TEACHING SUGGESTIONS:

1. Have the students read the first two paragraphs on page 291 and answer the italicized questions that follow the paragraphs. Teacher may paraphrase.
2. Discuss the questions with the students.
3. Divide the class into pairs.
4. Have each pair of students make a chart like the one on page 291.
5. Remind the students of the precautions they should exercise when using BTB.
6. Have several pairs of students at a time go to the supply table to get a tray of materials. Have them add small amounts of water to vials containing solids. Have them replace the cap on the vials and shake them to mix the solids and the water.
7. Have the students copy what is written in each vial on their charts in the first column.
8. Tell the students that they are to add a small amount of what is on one labeled vial to the BTB using the straws. Review, if necessary, the technique for using the straws as droppers that they used in the previous lesson.
9. Remind the students to record their results on their charts.

10. Circulate among the students providing help as it is needed. Remind the students to test the matter in the second vial after they have finished their first test.

11. Have the students return the trays of materials to the supply table. Then have them wrap the used straws in the newspapers and throw them away.

12. Have all the students wash their hands.

13. Make a chart on the chalkboard that is similar to the one on page 291. List in the first column all the materials that the students used.

14. Record the color change or lack of color change that the students observed on the chart on the chalkboard.

15. Have the students answer the numbered questions using the chart on the chalkboard. Write acid, base, or neutral beside each item on the chart.

16. Help the students to conlude from the chart that BTB changes to yellow in the presence of an acid, changes to blue in the presence of a base, and remains green in the presence of neutral matter.

17. Wash the BTB left in the vials down a sink. Be sure to wash your hands. Also pour the other materials down the sink. Thoroughly wash all the vials and place them where they will be ready for use in (5) A Breath Test.

DESIRED LEARNING OUTCOME: The students should be able to determine using BTB as an indicator which of a number of household substances contain acid and which contain base.

****

ENRICHMENT: Lesson Cluster 4C-2 Changes In Acids and Bases
Page T-497 Testing With Litmus (50 min.)

PURPOSE: To provide an opportunity for the students to use litmus as an indicator.

Language Cards/Key Signs
litmus

ADVANCE PREPARATION: Materials
- -1 vial or pill bottle for each student
- -vinegar
- -dishwashing liquid
- -containers, large, 946 mL (32 oz.)
- -vial of litmus paper strips, red and blue
- -1 tray for each pari of students

Separate vials of red and blue litmus paper strips are available from most scientific supply houses at low cost. If you cannot purchase litmus paper, you can perhaps obtain it from a local junior or senior high school science department.

Prepare solutions of vinegar and dishwashing liquids according to the directions on page T-491 of lesson 2. Save the remainder of the undiluted vinegar that is in the bottle for use in the first lesson of Cluster C-3. Write vinegar on the vials, fill them with vinegar solution, and cap them. Write soap on the other vials, fill them with soap solution and cap them. Place one vial of vinegar, one vial of soap, two pieces of pink litmus, and two pieces of blue litmus on each of the trays.

TEACHING SUGGESTIONS:

1. Use the introductory paragraphs on page S-293 to explain the use of litmus paper to the students. They are now going to have an opportunity to experiment with litmus working in pairs.

2. Hold up a vial marked vinegar and one marked soap. Explain to the students that these are the materials that they perviously tested with BTB. Now they are going to test them with litmus.

3. Hold up a piece of pink and a piece of blue litmus paper. Explain to the students that these are the litmus indicators that they will use to determine the presence of an acid or a base in the vinegar and soap solutions. The students are to dip a pink strip and then a blue strip into each vial. They are to observe carefully any color changes.

4. Divide the class into pairs.

5. Then distribute a tray of materials to each pair.

6. Caution the student not to put litmus paper in their mouths or near their faces. Explain that litmus paper contains a chemical that could be harmful to them.

7. Have the students begin to experiment.

8. Ciculate among the students providing help as it is needed.

9. Have the students return their trays and vials of vinegar and soap to the supply table. Have them fold up the strips of litmus paper and put the newspaper in the wastebasket.

10. Have the students wash their hands.

11. Make a chart on the chalkboard. Write Indicator, Color in Vinegar, and Color in Soap across the top. Write Limus and BTB under Indicator.

12. Discuss the lesson with the students using the chart.

13. Ask different students to go to the board to fill in the results of their tests with litmus. Have others go to the board to fill in the results of their previous tests with BTB.

14. Ask the students if vinegar and soap are acids or bases. Then have them check the chart that they made with the chart on page 293 to see how the charts compare.

DESIRED LEARNING OUTCOME: The students should be able to determine that blue litmus changes to pink in an acid but remains blue in a base and that pink litmus changes to blue in a base but remains pink in an acid.

****

DEVELOPMENT: Lesson Cluster 4C-2 Changes In Acids and Bases
Page T-496/S-293 Other Indicators (30 min.)

PURPOSE: To introduce methyl orange and review litmus as indicators and to provide additional practice in inferring the presence of acids and bases from pictured evidence.

ADVANCE PREPARATION: Materials -reproduction of chart on page 293 on board or transparency

Language Cards/Key Signs
indicators
litmus
methyl orange

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing with the students that there are other indicators besides BTB that will detect the presence of acids and bases in matter.

2. Have the students read page 293 and answer all the italicized questions. Teacher may paraphrase. Review the chart on the board making sure they know how to interpret it. Caution them to base the answers to the questions on evidence that they can observe in the pictures.

3. Circulate among the students providing help as it is needed.

4. Discuss the italicized questions with the students. Make certain that they give reasons for their answers based on evidence in the pictures or on data in the chart.

5. Discuss the numbered questions with the students.

6. The Enrichment Lesson Testing With Litmus should be done following this lesson.

DESIRED LEARNING OUTCOME: The students should be able to infer from evidence in pictures of interactions of methyl orange and litmus with liquids which liquids contain acids and which contain bases.

****

APPLICATION: Lesson Cluster 4C-2 Changes in Acids and Bases
Page T-498/S-294 A Breath Test (40 min.)

PURPOSE: To use BTB to detect acids and bases in gases.

ADVANCE PREPARATION: Materials -Each student will need:
- -1 container, wide mouth, plastic 250 mL (8 oz.)
- -1 drinking straw or medicine dropper
- -1 tray

Also have on hand:
- -1 container as above
- -1 drinking straw or medicine dropper
- -BTB
- -plastic bag
- -tape
- -paper clip, size #1

Language Cards/Key Signs
gases
indicators
acid
base
breath

Because the mineral content of water can change the outcome of the BTB experiment, test the BTB solution before filling all the containers. Fill just one containers with BTB and blow your breath through it. If the solution does not change color, add a small amount of baking soda to the class supply of BTB to make it slightly blue. The carbonic acid formed from breath is sometimes not concentrated enough to change BTB solution to yellow, but it will change blue BTB to green. Fill each of the 31 containers with 10 mL of BTB. Put one container of BTB and a straw on each of the trays.

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they are going to test gases for the presence of acids of bases. Have them read the first column on page 294.
2. Go over the Caution with the students. Emphasize that if they need to take a breath they must remove their mouths from the straws and then take the breath.
3. Distribute a tray of materials to each student.
4. Have the students do the activity and answer the italicized question at the top of the second column.
5. Have the students return their materials to the supply table and then wash their hands.
6. Ask the students to read the second column on page 294. Teacher may paraphrase.
7. Fold one end of a straw and attach a paper clip to hold it. Open a food storage bag and swoop it through the air. Insert the end of the straw without the clip in the opening, close the bag tightly around it, and tape the bag closed. Remove the paper clip and put that end of the straw into a container of BTB. Squeeze the bag to make bubbles.
8. Ask the students to describe the color of the BTB.
9. Discuss the numbered questions. Explain that carbon dioxide interacts with the

water in BTB solution to form a mild acid (carbonic acid).

10. Leave the containers of BTB uncapped overnight. Have the students observe the color of the BTB the next day.

DESIRED LEARNING OUTCOME: The students should be able to infer from a color change in BTB that an acid forms when they blow into BTB.

****

EVALUATION: Lesson Cluster 4C-2 Changes in Acids and Bases
Page T-499/S-295 Using Indicators (40 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Determining whether a liquid is an acid, a base, or neutral from descriptions of its interaction with litmus.
2. Determining the relative strengths of two acids from descriptions of their interactions with BTB.
3. Determining whether a household cleaner is an acid, a base, or neutral from pictured evidence of its interaction with BTB.

TEACHING SUGGESTIONS:

1. Have the students turn to page 295 and read through the lesson. Teacher may paraphrase.

2. Have the students proceed with the lesson when you are certain that they understand what to do.

3. Go over the responses when they have completed their work. If you wish, let the students correct their own papers so that they may evaluate their own progress.

4. Collect the papers so that you may evaluate each individual's progress. If a student correctly responds to all or the "a" part of each question, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 5 Unit 4 Matter and Energy

Part C Changes in Systems, Lesson Cluster 4C-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-504	Introduction	Chemical Change	45 min.
T-506	Introduction	Physical Change	35 min.
T-508	Development*	Two Kinds of Changes	
T-511	Application	Interaction of Acids and Bases	5 min.
T-510	Enrichment	Describe the Change	40 min.
T-512	Evaluation	What's The Change?	35 min.

NOTE: *This lesson should be done in 2 sessions. Enrichment lesson is optional.

B. MATERIALS: See materials list on page T-501.

INTRODUCTION: Lesson Cluster 4C-3 Chemical and Physical
Page T-504/S-296 Chemical Change (45 min.)

PURPOSE: To introduce the concept of chemical change.

ADVANCE PREPARATION:

Background Information - Whether or not a change is chemical can be determined from observation of the matter that forms as a result of interaction. If a new kind of matter with properties quite different from the properties of any objects in the interacting system forms, a chemical change has occurred.

Examples of chemical changes can be found in many places. New, chemically different matter forms in organisms as they grow. Fried, boiled, and baked foods are chemically different from theuncooked ingredients from which they are made. Changes in the color of common acid-based indicators are due to chemical change.

Materials - Each pair of students will need:
- 1 plastic container, wide mouth 250 mL (8 oz.)
- 1 vial or pill bottle, transparent with cap
- 1 piece of chalk
- 1 tray

Also have on hand:
- vinegar, from indicators, T-491
- measuring container
- aluminum pie pan (optional)
- lined paper
- matches
- container of water for safety

Language Cards/Key Signs
change
systems
chemical
physical
properties
matter

Identification Cards

Fill each of the plastic containers with 50 mL (1½ oz.) of undiluted vinegar. Break pieces of chalk into pieces that are 1.3 cm (0.5 in.) long. The pieces of chalk may vary somewhat in size. Put a piece of chalk into each uncapped vial. Place a container of vinegar and a vial containing chalk on each of the trays.

If you wish to demonstrate the chemical change in burned paper described on page 296, be sure that you first check with your principal to find out if it is permissible to use a flame in the classroom.

TEACHING SUGGESTIONS:

1. Introduce the cluster by explaining to the students that they are going to learn about chemical and physical changes in systems.

2. Demonstrate the experiment with the burned paper to reinforce what the students observed in the pictures if you have permission to use a flame in the classroom. Place the container of water beside the aluminum pie plate, safety matches, and piece of paper. Move all the students away from where you going to ignite the paper. If the demonstration is not possible have the students read column one and answer the italicized questions.

3. Hold up the container of water and ask the students what they think it is for. Stress the importance of having a supply of water nearby as a safety precaution whenever a flame is used. Explain to the students that you moved them away from where you will be working as another safety precaution.

4. Hold up the piece of paper and ask the students to describe its properties.

5. Tear the paper in half. Keep one half unchanged for comparison. Crumple the other half, place it in the aluminum pan, and ignite it with a match. Let the paper burn completely.

6. Have the students gather around you when you are sure that the paper has stopped burning.

7. Ask the students to describe the properties of what is left in the aluminum pan.

8. Place the half sheet of paper that you saved beside the ashes in the aluminum pan. Ask the students to compare the paper and ashes.

9. Stress that the matter formed after the paper burned is a new kind of matter because its properties are quite different from the properties of the original paper. The change in properties is evidence that a chemical change took place.

10. Have the students read the second column of page 296 to find out about the experiment that they are going to do. Teacher may paraphrase.

11. Divide the class into pairs and distribute a tray of materials to each pair of students and let them begin to work.

12. Circulate among the students providing help as it is needed. Remind the students to answer the italicized questions when they have completed their experiments.

13. Have the students return the trays with the vials and containers to the supply table.

14. Discuss the italicized questions in the second column of page 296 with the students. Help them to understand that the gas formed as a result of the interaction of the chalk and vinegar is a new kind of matter because of the chalk and vinegar is a new kind of matter because its properties are quite different from the chalk and vinegar. The formation of a new kind of matter is evidence that a chemical change took place.

15. Conclude the lesson by telling the students that there are many chemical changes in the environment and that they will be studying many such changes later in the cluster.

16. Wash the containers and vials thoroughly so that they will be ready for use in Two Kinds of Change.

DESIRED LEARNING OUTCOME: The students should be able to describe a chemical change in terms of the formation of a new kind of matter with properties that are quite different from the properties of the original objects in the interacting system.

****

INTRODUCTION: Lesson Cluster 4C-3 Chemical and Physical Change
Page T-506/S-297 Physical Change (35 min.)

PURPOSE: To introduce the concept of physical change.

ADVANCE PREPARATION:

Background Information - Whether or not a change is physical can be determined from observation of the matter that forms as a result of interaction. If the matter has properties that are the same as or very similar to the properties of the original objects in the interacting system, a physical change has occurred.

Changes in the size, shape, and motion of objects are typical physical changes. A stretched rubber band, a bent paper clip, sculptured clay, and sawed wood are all objects that have undergone physical change. Such phase changes in matter as the melting of ice, the freezing of water, and the evaporation and condensation of water are all physical changes.

Materials - none.

Language Cards/Key Signs
physical
chemical

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson by reviewing with the students how to tell whether a chemical change hass occurred as a result of interaction.

2. Tell the students that in this lesson they are going to learn about physical changes in objects.

3. Ask the students to read page 297 and answer the question. Caution them to look carefully for evidence in the pictures. Teacher may paraphrase.

4. Discuss the question and pictures with the students. Ask them to describe the changes in the pictured objects. (A: change in position; B: wood has been cut; C: change in size and phase). Then ask them if a new kind of matter was formed as a result of the changes. (no)

5. Be sure that the students understand the difference between chemical and physical changes before they go on to the second part of the lesson.

6. Have the students read the first column on page 298 and answer the italicized questions. Teacher may paraphrase.

7. Make a chart on the chalkboard. Write the headings Chemical Change and Physical Change across the top. Write potato, tablet, and lamp down the left side. Discuss the italicized questions with the students using the chart.

8. Have students go to the board to place a check in the column that tells the kind of change shown in the pictures.

9. Discuss the numbered questions. Encourage the students to think of chemical and physical changes other than the ones pictured in this lesson.

10. Write on the chalkboard the general rules for distinguishing between a chemical and a physical change that the students give in answering question 3. Have the students decide on the best rules.

DESIRED LEARNING OUTCOME: The students should be able to describe a physical change in terms of interactions that result in changes in which no new kind of matter is formed.

****

DEVELOPMENT: Lesson Cluster 4C-3 Chemical and Physical Changes
Page T-508/S-299 Two Kinds of Changes

PURPOSE: To identify physical and chemical changes.

ADVANCE PREPARATION: Materials - Each pair of students will need:
- 2 plastic containers, wide mouth, 250 mL (8 oz)
- 1 vial or pill bottle with cap
- 1 tray
- 1 empty tea bag
- 1 stirrer, such as for coffee
- 1 square of aluminum foil, 10 cm x 10 cm (4 in. x 4 in.)
- 1 black crayon

Also have on hand: copper chloride, 454 g (1 lb.)
scissors
class supply of water
newspaper

Language Cards/Key Signs
chemical
physical
copper chloride

Identification Cards

Copper chloride may be purchased from scientific supply houses. A 454 g (weighing 1 lb.) jar is more than enough for you to use in this lesson. What is left over may be stored for use next year. Fill each of the vials one-quarter full of copper chloride and cap them. Place a vial of copper chloride, an empty tea bag, a container of water, and a stirrer on each of the 15 trays.

Put the foil squares or cups aside until the students are ready to use them in the second part of the lesson.

Plan now whether you wish to complete all of the lesson except for the portion that involves evaporation overnight or to take two days to do the lesson. If you decide on the latter, end the first day's lesson after the first paragraph on page 300.

Clear a space where the students may store their inverted tumblers overnight. Cover the area with newspapers.

TEACHING SUGGESTIONS:

1. Introduce the lesson by explaining to the students that they are going to do some experiments in which they will have to determine whehter the changes that they observe are chemical or physical changes.

2. Divide the class into pairs.

3. Ask the students to read page 299. Teacher may paraphrase.

4. Go over the Caution with the students. Emphasize that they should keep their hands away from their faces when they are using the chemical copper chloride. Emphasize that they are to use the stirrers to transfer the copper chloride rather than their hands. Explain that they will wash their hands after they complete the lesson even after using the stirrers.

5. Go over the directions on page 299 step by step with the students. Be sure that they observe each step in the pictures. Emphasize that they are to wet the top edge of the tea bag in the container of water they will be given. They are not to lick it or put it into their mouths.

6. Distribute a tray of materials to each pair of students and have them begin to work. Remind the students to answer the questions at the end of page 299.

7. Discuss the italicized questions with the students.

8. Have the students add the rest of the copper chloride in the tea bag to the water. After the bags are empty, have them remove the bags, stir the solution, and set it aside.

9. Pass around a newspaper and ask the students to pick up the empty tea bags with their stirrers and put it on the newspaper. Fold up the newspaper and throw it away.

10. Ask the students to read the first paragraph on page 300 and look at the picture. Teacher may paraphrase.

11. Discuss the picture with the students. Make sure they understand that they are to invert eh clean container that you will give them and transfer only a few drops of copper chloride solution to the top of it with their stirrers. Point out the area where they are to leave the containers overnight.

12. Distribute the clean containers and the crayons. Ask the students to put their names on the outside of the clean container and the container of copper chloride solution before transferring drops of liquid.

13. Have the students begin to work. As they finish, have them take their containers to the area you have cleared. Plan to end the lesson at this time and continue with the aluminum foil experiment on another day.

14. Divide the class into the same pairs that previously worked together.

15. Have the students get their inverted containers.

16. Ask the students to observe what happened to the drops of copper chloride and then answer the italicized questions under the picture in the first column on page 300.

17. Discuss the questions with the students.

18. Have the students take the inverted containers back to the area where they were stored and get their containers of copper chloride solution and a stirrer.

19. Ask the students to read the last two paragraphs of the first column on page 300 and the second column as far as the numbered questions to find out what they are going to do. Teacher may paraphrase.

20. Discuss the picture in the second column with the students. Caution the students not to put their fingers in the copper chloride solution.

21. Distribute the aluminum foil squares to the students and have them begin to work.

22. Circulate among the students providing help as it is needed. When the new kind of matter forms in the bottom of the containers, encourage the students to remove some with their stirrers and place it on the newspapers so that they may observe it more easily.

23. Discuss all the italicized questions with the students and then the numbered questions. Ask the students if the system that they worked with on page 299 is the same system that they worked with on page 300. (No, because matter was added to the system on page 300.)

24. Have the students return the containers to the cleared area, fold up the newspapers and throw them away, and wash their hands.

DESIRED LEARNING OUTCOME: The students should be able to determine from their observations that the interaction of copper chloride and water is a physical change and the interaction of copper chloride solution and aluminum is a chemical change.

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660

APPLICATION: Lesson Cluster 4C-3 Chemical and Physical Change
Page T-511/S-301 Interactions of Acids and Bases (50 min.)

PURPOSE: To apply what has been learned about chemical change to the interaction of acids and bases.

ADVANCE PREPARATION:

Background Information - A chemical change resulting in the formation of a salt and water occurs when the acids and bases interact. For example, when hydrochloric acid interacts with lye or sodium hydroxide (a base), sodium chloride (a salt) and water form. The salt formed happens to be ordinary table salt. However, any new kind of matter that results from the interaction of an acid with a base is called a salt.

Materials - BTB
- 2 clear plastic glasses
- vinegar
- water
- clear ammonia

Instead of only using the pictures in this lesson to make observation, the teacher will reproduce the experiment so that the students can directly observe the interactions.

Language Cards/Key Signs
acids
bases
interact
salt
copper chloride
physical change
chemical change
evaporation

Identification Cards

TEACHING SUGGESTIONS:

1. Teacher should begin with a clear glass filled with water. Add 3-4 drops of BTB and then add vinegar, drop by drop, until the yellow color occurs as in picture A.

2. Ask the students whether the interaction of BTB with acid is a chemical or physical change. (chemical: new kind of matter formed)

3. Add clear ammonia to the solution until the color changes to green as in picture B.

4. Discuss the interaction of a base and an acid. Have the students answer the questions at the top of the second column. Then ask them whether a chemical or physical change took place when the base interacted with the acid, (chemical: new kind of matter formed)

5. Ask the students to read the second column as far as the numbered questions and look at picture C. In addition to using the picture, add a few drops of the green liquid to the other glass and let it evaporate overnight. Let the students check it the next day and compare it to picture C.

6. Write the term evaporation on the chalkboard and ask the students what happens to a liquid when it evaporates. Students who have done the fourth-level unit Patterns will probably remember learning that water goes into the air, or evaporates, in the water cycle. Discuss the italicized question below the picture.

7. Write the term salt on the chalkboard. Emphasize that table salt is just one kind of salt. Many different salts form when different acids interact with different bases.

8. Discuss the numbered questions.

9. The Enrichment Lesson Describe the Changes should be done following this lesson.

DESIRED LEARNING OUTCOME: The students should be able to explain that the interaction of an acid with a base is a chemical change because a new kind of matter is formed.

****

ENRICHMENT: (optional) Lesson Cluster 4C-3 Chemical And Physical Change
Page T-510 Describe the Change (40 min.)

PURPOSE: To apply what has been learned about chemical and physical changes to familiar changes in the environment.

ADVANCE PREPARATION: Materials - none

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to think of as many changes as possible that they have observed around them. Suggest that they think of changes that they have seen at home, on the way to and from school, on vacation, or at school.

2. Make a chart on the chalkboard. Write the headings Change, New Kind of Matter Formed, Physical Change, and Chemical Change across the top.

3. Ask the students to name the changes that they thought of so that you can list them on the chart. Accept all the changes that the students name even though they may be difficult to deal with later.

4. Tell the students that to fill in the rest of the chart they will have to determine first whether or not each change resulted in the formation of new kind of matter. Have the students take turns going to the board to write yes or no in the second column of the chart. Tell the students that after the whole column has been filled in they will have an opportunity to disagree with what has been written beside any change. Do not feel obligated to solve all problems that arise. If the students cannot determine whether a new kind of matter was formed place a question mark in the column and proceed.

5. Provide an opportunity for the students to express their disagreement with what has been written on the board. Be sure that they give reasons for their disagreement. Change incorrect responses on the board as the students find them.

6. Call on students who have not had a chance to go to the board to place a check mark in either of the last two columns on the chart to indicate whether each change was physical or chemical. After each change has been so designated, provide the students with an opportunity to disagree. Correct any misplaced check marks.

7. Help the students to find patterns in what has been recorded on the chart. For example, they may say that cooking, baking, frying, the growth of organisms, decay, digestion, and acid-base interactions are all chemical changes. The students might say that expansion, contraction, changeof phase, physical collision, and changes in shape, size, position, and motion are ally physical changes.

8. Conclude the lesson by stressing that determining whether or not a new kind of matter has formed as a result of interaction makes it relatively easy to tell whether a change is physical or chemical.

DESIRED LEARNING OUTCOME: The students should be able to determine whether changes that are familiar to them are physical or chemical changes.

* * *

EVALUATION: Lesson Cluster 4C-3 Chemical and Physical Change
Page T-512/S-302 What's the Change? (35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Determining whether or not a new kind of matter is formed as a result of interaction.
2. Distinguishing between a physical and a chemical change.

TEACHING SUGGESTIONS:

1. Have the students turn to pages 302 and 303 and read through the lesson. Teacher may paraphrase.

2. Have the students proceed with the lesson when you are sure that they understand what they are to do.

3. Go over the response with the students when they have completed their work. If you wish, let the students correct their own papers so that they may evaluate their own progress.

4. Collect the papers so that you can evaluate each individual's progress. If a student can correctly identify at least one physical change and one chemical change, and can correctly explain at least once that the determination was made on the basis of whether or not a new kind of matter was formed, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

5. For further informal evaluation, have the students turn back to page 282 and look at the picture that introduced Part C. Ask them why they think that particular picture was used to introduce the part that they have just completed. Suggest that they look for clues in the part title and in the cluster titles on pages 283, 289, and 296. The students should be able to:
   a. infer that the fire-wood system has been changed because matter (hot dogs) was added to it;
   b. infer that burning caused a chemical change in the wood because a new kind of black matter formed;
   c. infer that cooking caused a chemical change in the hot dogs because a new kind of matter was formed.

* * *

LEVEL 5

SIGNED VOCABULARY AND LANGUAGE INDEX
FOR
SCIENCE FOR THE HEARING IMPAIRED

Instructions for use of this index with the accompanying signed videotapes are found in the Introduction to the Program. This index should be used as a script when viewing the signed videotapes for the specific SFHI cluster or section of interest.

Each part of the videotape is preceded by an indication of the specific location (level, unit, part, Cluster and Lesson) of the item presented. Each item within a lesson is first presented in American Sign Language (ASL) followed by a Manually Coded English (MCE/SEE) presentation of the same item. When a lesson list is completed the title of the next lesson is given, followed by a presentation of each new lesson item in ASL and MCE.

Teachers should view the videotape in planning for each new cluster (2-5 minutes per cluster). It is also suggested that teachers view and practice the signs presented with their classes following lesson experiences or as a review. The videotape can be used as a visual dictionary when the children have forgotten the sign.

The Signed Vocabulary and Language Videotapes are available for purchase and/or copying by writing

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Science for The Hearing Impaired
Signed Vocabulary for Level 5

Lesson	Title and Key Signs
Cluster 1A-1	Protective Adaptations
1	Toothpick Hunt
2	Structures Have Functions chameleon structures function
3	Structures That Help organism environment adaptation
4	Protective Color & Shape color shape predators protective
5	Defense Structures defense structure porcupine structure quills skunk
6	Protective Coverings covering protective coverings
7	Plant Protection protect protective coverings
8	Human Coverings skin fingernails eyelashes hair
9	Finding Adaptations
Cluster 1A-2	Getting Food
1	How an Octopus Eats octopus protection protective structures predators
1(cont)	prey suckers
2	Kinds of Teeth teeth structure adaptation predator wide and flat teeth sharp and pointed teeth
3	Insect Mouth Parts mouth parts insect Harvester ants mosquito butterflies
4	How Animals Move environment structure chameleon turtle
5	Movement Structures outside adaptations movement structures monkeys seals flamingos environment
6	Plant Structures plants roots vines seaweed stem lilypad tubes plant structures
7	Functions of Structures

Lesson Title and Key Signs

Cluster 1B-1 Systems

1 On the Inside
inside structures
system
skeleton
stomach
lungs
heart
interact
leg bone
brain
intestines

2 A Chicken Skeleton
skeletal system
bones
joint

3 Respiratory Systems
respiratory system
oxygen
breathe
gills
lungs
air holes
air tube

4 Digestive System
digestion
digestive system
food tube
intestines
anus
crop
gizzard
stomach
cud

5 A Muscular System
muscular system
muscles
relax
contracts
biceps

6 Systems Interact in the Hands
thumb

7 Systems Have Parts

Lesson Title and Key Signs

Cluster 1B-2 Cells

1 What are Cells? & Looking at Cells
a cell
a microscope
a nucleus
a slide
a plant cell
an animal cell
a microscope
some plant cells
some animal cells

2 Cell Structures
cell structures
a cell membrane
a cell wall

3 Cells in Your Body
human muscle cells
human skin cells
red blood cells
white boood cells
human blood cells

4 One-Celled Organisms
pond water
one-celled

5 Properties of Cells

Cluster 1C-1 Animal Behavior

1 What is Behavior?
behavior

2 Eye Behavior
eye behavior
pupil

3 Earthworm Behaviors
earthworm
adaptation

4 Behaviors Have Functions
deer
spider
monkeys
geese
racoon

Lesson	Title and Key Signs
Cluster 1C-1 (cont)	
4 (cont)	rabbit bobcat adaptation
5	Inborn or Learned inborn behaviors learned behaviors
6	Learn a Behavior practice trial
7	Behaving
Cluster 1C-2	Plant Behavior
1	Responses of Plants plant behavior Venus Fly Trap mimosa plant cucumber, squash or pea plant
2	Behavior in Light
3	Tendril Response tendrils tendril response pea plants grown w/string pea plants grown w/o string
4	Response to Gravity gravity roots stem
5	Changes in Plants
Cluster 1D-1	Animal Stages
1	Growth in Organisms stages organisms adaptations
2	Stages of Mealworms mealworms life stages egg larva

Lesson	Title and Key Signs
2(cont)	pupa beetle molting
3	A Chicken Egg chicken egg yolk egg shell egg white properties
4	Parents and Offspring parents offspring
5	Human Stages human stages infant stage child stage adult stage elderly stage
6	Living in Stages
Cluster 1D-2	Plant Stages
1	Stages of Pine Trees stages plants pine tree pine cones bark trunk pine twigs
2	Seed Adaptations adaptations seed sprout soaked bean sprout pea seed
3	Flower Adaptations flower reproduce sepals petals stamens pistil eggs

Lesson	Title and Key Signs
Cluster 1D-2 (cont)	
3(cont)	pollen tube fruits pollen grains pollen nectar wind-carried
4	Scattering Seeds sprouts scatter wings parachutes burrs structures
5	Stages in Plant Growth
Cluster 2A-1	Identifying Forces
1	What is a Force? force push pull
2	Energy Causes Changes energy interact energy transfer system evidence
3	Balanced Forces balanced forces movement
4	An Interaction Game interaction balanced unbalanced
5	Three-Way Tug of War
6	Showing Forces force direction
7	Understanding Forces

Lesson	Title and Key Signs
Cluster 2A-2	Measuring Forces
1	A Force Measurer force measurer
2	Units for Your Measurer units force washer
3	Using Your Measurer downward force washer units decimal
4	Checking Your Measurer
5	Using a Spring Scale spring scale newtons
6	Weight is a Force weigh force gravity
7	Comparing Scales compare
8	Combine Scales combine
9	Everyday Scales
10	Weighing In
Cluster 2B-1	Forces in Liquids
1	Objects in Water weight objects liquid
2	Weighing in Water
3	Other Liquids liquid evidence

Lesson	Title and Key Signs
Cluster 2B-1 (cont)	
4	Buoyant Forces buoyant force gravity
5	Floating liquid float buoyant aluminum foil objects that float objects that sink
6	Making Boats
7	What is Buoyant Force? buoyant force volume displaced displaces
8	Weight and Mass weight mass matter buoyant force
9	Measuring Mass mass kilograms grams balance
10	Feeding the Fish
Cluster 2B-2	Forces in Gases
1	The Air Around Us air gases windmill force liquid
2	Air Can Cause Pushes
3	Measuring Pushes push trapped air
4	Making a Rocket rocket rocket system variable
5	Adding A Return Rocket balloon rocket return rocket
6	Carrying A Load load
7	Rocket Action balanced force unbalanced force
8	Balloon Watching
Cluster 2B-3	Volume
1	What is Volume? volume cubic centimeters cube
2	liquid volumes liquid volume level
3	Finding Volumes unmarked containers estimated measured
4	Volume of Solids solids volume displaces length width height regular solid
5	Weighing Water weighing weight volume water newtons

Lesson	Title and Key Signs
Cluster 2B-3 (cont)	
6	Volume and Weight volume weight double equal
Cluster 2C-1	Putting Forces to Work
1	Making Things Move variable system move change movement
2	What Makes Things Move variable force smoothness
3	Friction friction interact
4	Changes Directions
5	The Inclined Plane incline plane simple machine
6	Inclined Planes
7	Wedges wedge simple machines
8	Comparing Forces
Cluster 2C-2	Working With Inclined Planes
1	Energy Transfers energy transfer energy giver energy receiver transfer
2	Energy Transfer With Inclined Planes energy transfers inclined planes direction force
3	A Paper Dragon paper dragon variables systems friction
4	Changing the Paper Dragon variable constant reliable
5	Changing Other Variables
6	A Research Project
Cluster 2C-3	Levers
1	Making A Lever lever simple machine fulcrum
2	Measuring Lever Action levers
3	Making A Balance balance
4	Balancing Forces forces constant
5	Using Levers
6	Balancing Levers
Cluster 3A-1	Objects and Motion
1	Evidence of Motion evidence motion
2	Reference Objects reference objects

Lesson	Title and Key Signs
Cluster 3A-1 (cont)	
3	Relative Motion relative to relative motion reference objects
4	Using Reference Objects position
5	What Moved?
6	What Is Moving? relative to moved reference object
7	Identify the Movers
Cluster 3A-2	Records of Motion
1	Before and After evidence photograph motion
2	Blurred Pictures blur relative to evidence of motion
3	Tracks and Trails tracks trails motion records
4	Collect Some Tracks
5	Reading Tracks
6	Motion Detective
7	What's the Evidence?
Cluster 3A-3	Circular & Rotary Motion
1	Circular Motion
1(cont)	circular motion reference object straight-line motion
2	Rotary Motion rotation axis axis of rotation sphere
3	Finding the Axis rotate
4	Clockwise & Counter Clockwise clockwise counter clockwise
5	The Earth's Rotation sphere axis earth rotation
6	The Traveling Moon
7	Night and Day night day
8	Describing Circular & Rotary Motion
Cluster 3B-1	Reference Frames
1	Meet Owl owl reference reference object right left above below in front in back observer close far
2	Name the Fruit
3	Find the Objects

Lesson	Title and Key Signs
Cluster 3B-1 (cont)	
4	Owl Describes Motion relative to moving
5	Owl Reference Frames reference frame starting point starting direction direction distance
6	A Treasure Hunt
7	Using More Than One Owl
Cluster 3B-2	Using Numbered Circles
1	Owl and Circles numbered circles reference frame clock clockwise distance degree circle starting point starting direction direction
2	A Helicopter View polar grid degrees
3	Direction to Cities
4	A Reference Frame at Sea polar grid coordinates
5	Radar and Reference Frames radar reference frames
6	Locating Positions
Cluster 3B-3	Using Numbered Lines
1	Map Reading numbered lines
1(cont)	map landmark
2	Map of a School
3	Map of a Classroom
4	In An Old Western Town directions pattern
5	Identify the Position coordinates reference frame polar grid left right across rectangular grid
6	Grid Game
7	Flip Books and Grids position motion grid paper flip book sphere
8	Describing With Numbered Lines
Cluster 3C-1	Moving Air and Flying Objects
1	Who Has Seen the Wind
2	Model A Pinwheel motion direction pin wheel prediction clockwise counter clockwise
3	Model B Pinwheel
4	String Power unbalanced force predict
5	Box Kites

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students to read or paraphrase for them page 126 down to the numbered questions.

2. Have the class look at the picture of the carving.

3. Start a discussion of the italicized questions on page 126.

4. Ask the students what it might be safe to infer, and what it might not be safe to infer. This should stimulate some critical thinking.

5. Ask the students what they might be able to infer if they suddenly came upon the pyramids.

6. Conclude the lesson by having the students discuss the numbered questions at the bottom of page 126.

DESIRED LEARNING OUTCOME: The students should be able to make inferences about the skills and lifestyles of the people who made the ancient carvings.

****

APPLICATION: 2B-2 Models of Past and Present
Page T-222/S-127 Models of the Past (35 min.)

PURPOSE: To apply the concept of making inferences to building a general model of a past system.

ADVANCE PREPARATION: Materials - none.

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the class to think of three articles that might go together to give a picture of what their lives are like. Tell them to suppose that a space traveler landed on Earth and wanted to find out about the culture of a twentieth-century sixth grader. What articles would best convey that impression?

2. Have the class read the lesson page 127.

3. Discuss the italicized questions with the students.

4. Ask the class whether the artifacts that they left for the space traveler would give a more realistic or a less realistic impression than the articles in the photographs on page 127. Have them explain their responses.

5. Conclude the lesson by discussing or assigning the numbered questions at the bottom of page 127.

Language Cards/Key Signs

one rope
a branding iron
a wagon wheel
some bones
auto tire
inference
evidence
observations
model
objects

Identification Cards

DESIRED LEARNING OUTCOME: The students should be able to build a general model of a past system.

****

APPLICATION/ENRICHMENT: 2B-2 Models of Past and Present
Page T-223 Time Capsules (35 min.)

PURPOSE: To strengthen awareness of the tentative nature of models based on inference. This lesson does not appear in the student text.

ADVANCE PREPARATION: Materials - 1 large box

Language Cards/Key Signs
time capsule
a baseball bat
alien
a long playing record
a scarf
model
Identification Cards
a time capsule
(objects in time capsule)

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the class to suppose that aliens landed on Earth and discovered only a baseball bat, a long-playing record, and a scarf. What conclusions do you think they might draw? Encourage a wide variety of answers. After the class is through discussing their opinions, suggest that the aliens might conclude that the scarf is an article of clothing, probably worn about the waist. The record might be a hat, the hole in middle indicating that people have spikes on the tops of their heads. The bat might be a war club.

2. Ask the students whether they think the above is a fair appraisal of Earth life.

3. Ask the class how they would go about assuring that a future generation might be able to get a realistic model of what life is like on Earth at present. Encourage a variety of responses.

4. Have the students try to separate today's life into major categories such as technology, entertainment, dress, the arts, government. What would they leave from each area if they were assembling a time capsule to be opened in the future?

5. Tell the class that previous generations have buried time capsules meant to be opened in the future.

6. You may wish to conclude the lesson by assigning the students the task of creating a time capsule by bringing in one article to be put in a box (time capsule). The time capsule might be exchanged with another class or saved in an obvious place and opened later by the same class at the end of the year. Does the contents of the box form an adequate model of what we are?

DESIRED LEARNING OUTCOME: The students should be able to report that inferences made from incomplete data are tentative.

****

EVALUATION: 2B-2 Models of Past and Present
Page T-224/S-128 Models of the Present (35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Developing a model for a system involving certain objects.
2. Developing a model of a person who might use a certain collection of objects.
3. Inferring a model of a past event by observing evidence in the present.

ADVANCE PREPARATION: Materials - for each student
- 1 sheet, unlined paper
- 1 pencil

* for 1st lesson in next cluster ask students to bring in a board game. If students report they have none, secure one game for every 2 students from another source.

TEACHING SUGGESTIONS:

1. Have the students turn to text page 128 and read or paraphrase for them through the lesson.

2. Be certain the students understand what they are to do.

3. Distribute paper and pencils and have the students write their responses.

4. Go over the students' responses when they have finished their work. You may wish to let the students correct their own papers to enable them to evaluate their progress.

5. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 6 Unit 2 Models

Part B Models of Systems, Lesson Cluster 2B-3

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-230 T-231	Introduction/ Enrichment	Learning From Models and Games as Simulation Models	50 min.
T-232	Development (2 lessons)	Litterbug	50+50 or 100 min.
T-235	Application	A Simulation Model	45 min.
T-236	Evaluation	Models Everywhere	30 min.

NOTE: Lesson 1 and 2 are combined into one lesson. Lesson 3 is split into two lessons

B. MATERIALS: Add the following to the list on page T-227:
-ask students to bring in (or obtain a few yourself) board games to be used in lessons 1 and 3 in the Cluster
-make copies of play money in appendix G for Lesson 2.

FILMSTRIP INFORMATION: Filmstrip Sets XIV, Size, Scale and Models, and XIX, Models, are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2B-3 Simulation Models
Page T-230-231/S-129-130 Learning from Models and Games as Simulation Models (50 min.)

PURPOSE: To introduce the concept of simulation models. Part of this lesson does not appear in the student text.

ADVANCE PREPARATION:

Background Information: Simulation models help pilots fly aircraft and astronauts guide spaceships. Such models also enable scientists to study processes and improve upon them before testing the processes full scale. A simulation model may start out as a very poor model, but then be improved over and over again until it becomes an excellent model. The closer a simulation model is to reality, the better the model is. Simulation models are designed to include many of the interactions of the actual system, but need not have all the system's properties.

Language Cards/Key Signs
simulation
Simulation Model
a board game

Identification Cards
(Board game names)

Materials -for each group:
-1 sheet pined paper and 1 pencil
-1 board game (students have brought from home - make sure to initial pieces to prevent their being lost)
For most classes the use of only one type of board game (Checkers) might prove more successful than many.

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students whether they are familiar with any games that imitate real-life situations.

2. Show the Language Card for the word simulation. Tell the class that a model that imitates real-life situations is called a simulation model.

3. Have the class read or paraphrase for them the first two paragraphs on page 129.

1. Divide the class into groups - two students for each game available. Have them look over the game.

2. Inform the students that they are going to evaluate each game as a simulation model.

3. Write the following question on the chalkboard:
   What real-life situation might your game model be like?

4. Ask them to respond to this questions. Accept all answers.

5. Paraphrase the rest of the first column on page 129 and discuss the italicized question with the class.

6. Discuss the numbered questions on page 129 to reinforce and extend the students' thinking on the subject of simulation models.

7. Write the following questions on the blackboard:
   How does your game differ from the real situation? How could your game be improved to better resemble the situation that it models?

8. Instruct each group to discuss each question. If time permits, they may wish to play one or more rounds of the game before they answer these questions. While the students are working, circulate and give assistance as required. (This group activity may be deleted. Proceed to 9.)

9. Conclude the lesson by discussing the questions with the whole group.

DESIRED LEARNING OUTCOME: The students should be able to state that simulation models are like real-life systems in many ways, and are useful for studying actual systems.

The students should be able to evaluate the accuracy of a simulation model and suggest improvements to make the model more realistic.

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DEVELOPMENT: Lesson Cluster 2B-3 Simulation Models
Page T-232/S-130-131 Litterbug (50 min. for each lesson)

PURPOSE: To develop the concept of simulation models by having the students work with a simulation game.

ADVANCE PREPARATION: Materials -for each group:
- 2-3 pencils
- 1 piece unlined paper, as large as possible
- 6 small index cards, cut in half (12 pieces)
- 1 30 cm ruler
- 2-3 scissors
- 3 copies play money, appendix G of Teacher text

Sketch a rough copy of the Litterbug gameboard on the blackboard. The class should be divided into groups of two or three students, each group developing and playing one game of Litterbug. Of course, the number of cards that each group uses will vary, depending upon how complex each group's game becomes. It is therefore a good idea to keep some cards in reserve.

Language Cards/Key Signs
Penalty card
Reward card
Litterbug Game
Simulation Model
simulation
players
gameboard
play money
littering
anti-littering
environment
real-life

Identification Cards
(same as above)

TEACHING SUGGESTION: (2 lessons are suggested)

First Lesson

1. Introduce the lesson by telling the students that they are going to help invent a game during this lesson.

2. Divide the class into groups of two or three students each.

3. Paraphrase the lesson on page 130, stopping at the appropriate times to discuss questions. Have the students look at the copy of the gameboard sketched on the blackboard. Have them look carefully at the gameboard and cards pictured on page 130-131.

4. Explain that the gameboard shown, as well as the reward and penalty cards on page 130 is only a sample. The students will need to make additional reward and penalty cards. They can also make changes in the gameboard, using or replacing items as they wish. The number of squares can be changed, too.

5. Distribute the materials.

6. Have the students cut out a supply of the play money from Appendix G.

7. Let each student make a playing piece from one of the index cards, and label it with a name or picture.

8. Have the students make copies of the reward and penalty cards on the index card halves.

9. Have the students play the game. The gameboard in the book may be used first.

Later the students can draw a modified gameboard on the large paper. When the students have played one game or enough to get into the nature of the game, have them reread page 130 and make at least one change before they play the game again. (Add a penalty or reward card, change the gameboard or change the rules.)

10. Circulate and give assistance where needed. Have them play additional games changing something each time.

11. End the lesson by telling the students the next lesson they will continue to use the game. Collect them so they can further refine them in the next lesson.

Next Lesson

12. Pass back the Litterbug games.

13. Begin the lesson by having each group explain and show their game, the changes they made and whether they liked the results.

14. Paraphrase page 132. Ask the students to discuss each part, the italicized questions and the numbered questions. Refer back to the actual game as much as possible. Have students suggest ways of changing the game to make it more real.

15. Collect the games so that the students may try playing again and further refining their models.

DESIRED LEARNING OUTCOME: The students should be able to modify a simulation model to make it a closer approximation of a real-life situation.

****

APPLICATION: Lesson Cluster 2B-3 Simulation Models
Page T-235/S-133 A Simulation Model (45 min.)

PURPOSE: To apply the concept of simulation models to product testing.

ADVANCE PREPARATION:

Background Information: Many organization - magazines, consumer test groups, and federal and state agencies - test automobiles to compare their low-speed and high-speed handling characteristics. The simulation model they use is a series of rubber or plastic cones that represent obstacles that must be avoided. The top speed at which the vehicle successfully negotiates the course is used as the measure of its manueverability.

The reason for use of the cone simulation model should be apparent. A car that fails to negotiate the course will not sustain any damage from hitting a plastic cone. Second, hitting a cone does not present a threat of injury to the driver of the test vehicle.

Language Cards/Key Signs

Simulation Model
cone
magazine
test

TEACHING SUGGESTIONS:

1. Introduce the lesson by having the students read or paraphrase for them page 133 as far as the numbered questions.

2. Have the class discuss the italicized questions.

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3. Ask the students why they think that cones are used instead of real cars and other obstacles. They should realize the danger in using real obstacles and cars, as well as the cost in property damage.

4. Ask the students how they would develop a simulation model to test the brakes (etc.) on a car.

5. Conclude the lesson by having the students discuss the numbered questions at the end of page 133.

6. For the Enrichment that follows this lesson, the students could play additional games with changes in Litterbug or return to page T-231 and investigate other games in and changes which could be made in them.

DESIRED LEARNING OUTCOME: The students should be able to describe how simulation models are applied to the testing of products.

****

EVALUATION: Lesson Cluster 2B-3 Simulation Models
Page T-236/S-134 Models Everywhere (30 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Identifying ways in which games are simulation models for real-life situations.
2. Listing ways to make a specified situation model realistic.

ADVANCE PREPARATION: Materials -enough for each student:
-1 pencil
-1 piece lined paper

Language Cards/Key Signs
model
Simulation Model
game
simulate
checkers
pieces

TEACHING SUGGESTIONS:

1. Paraphrase page 134 down to and including question 4 (delete questions 5 and 6).

2. Be certain that the students understand what they are to do.

3. Distribute the materials and have the students read and answer the questions.

4. Go over the students' responses with them when they have completed their work. You may wish to let the students correct their own papers to enable them to evaluate their progress.

5. Collect the papers so that you can evaluate each individual's progress. If a student responds correctly to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 6 Unit 2 Models

Part C Using Models, Lesson Cluster 2C-1

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-242	Introduction	Weather Symbols	50 min.
T-244	Development	Recording Your Own Weather	50 min. over 3 days
T-246	Development	Weather Map Models	25-35 min.
T-248	Application	Your Weather Predictions	50 min. over 2 days
T-249	Evaluation	Predicting From Weather Map Models	35 min.

B. MATERIALS: Add the following to the list on page T-239:
- 5 strips of posterboard 20 cm x 60 cm
- 1 set colored pencils or felt pens

FILMSTRIP INFORMATION: Filmstrip Sets XIV, Size, Scale and Models, and XIX, Models, are appropriate for use in this unit.

INTRODUCTION: 2C-1 Predicting From Models
Page T-242/S-136 Weather Symbols (50 min.)

PURPOSE: To introduce the concept of predicting from models.

ADVANCE PREPARATION: Materials - enough for each group:
- 1 posterboard strip 20 cm x 60 cm
- 1 set colored pencils or felt pins
- 1 30 cm ruler

It is a good idea to familiarize yourself with the weather map symbols on page 136 of the student text before teaching the lesson. That way you will be able to cope with any difficulties that the students may encounter.

Language Cards/Key Signs
weather
weather map
weather symbol
predict
model

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students why it is useful to predict the weather.

2. Have the class read or paraphrase for them page 136 and look at the various weather symbols.

3. Discuss the fact that wind direction is the direction from which the wind is coming. That is, an east wind is a wind blowing from the east toward the west.

4. Ask the students to describe the difference between the cold-front symbol and the warm-front symbol. Point out that the direction in which the front is moving is depicted by an arrow.

5. Ask the students what they notice about the wind-speed symbols. Make sure that they realize that the lengths of the angular lines denote the velocity, in units of 8 kilometers per hour. Be sure that they notice also that the symbols show not only the velocity of the wind, but also the direction from which it is blowing.

6. Have the students construct mini-charts one for each weather component. Have them write the name with symbols below. The following should be done - fronts, windspeed, wind direction, present weather, cloud cover, in groups of 1 or 2. Distribute materials and provide guidance. Place these strips in a prominent place in the room for the next week.

7. Let the class examine the symbols for present weather and for cloud cover.

8. Have the class as a group decide on the appropriate symbol for the present outside weather and cloud cover. Draw these symbols on the board.

9. Have them examine the top right rectangle in the illustration on page 136 and try to interpret it.

10. Paraphrase page 137.

11. Let them examine the weather map illustrated on that page.

12. Conclude the lesson by having the children answer the numbered questions at the bottom of page 137.

DESIRED LEARNING OUTCOME: The students should be able to state that weather maps are models used to describe and predict weather.

****

DEVELOPMENT: 2C-1 Predicting From Models
Page T-244/S-138 Recording Your Own Weather (50 min. over 3 days)

PURPOSE: To develop the concept of predicting from models.

ADVANCE PREPARATION: Draw a chart similar to page 138 on the board. Prepare copies of Checking Weather Predictions, Appendix H, for use by students. A copy of today's or yesterday's newspapers.
Materials - enough for each student
- 1 pencil
- 1 Checking Weather Predictions
- 1 30 cm ruler

Language Cards/Key Signs
record
temperature
wind speed
wind direction
cloud cover
weather
prediction
actual weather

TEACHING SUGGESTIONS:

1. Ask students how they find out what the weather will be tomorrow. Encourage them to name as many sources of weather prediction as possible (radio and television stations, newspapers, National Weather Service, and so on). If possible, try to bring in a newspaper that gives weather predictions. List all these sources on the chalkboard.

2. Next ask students to discuss the accuracy of these predictions, if the subject has not already come up. Tell students that they will be keeping records to see how accurate the weather predictions are.

Identification Cards
weather chart
(put up in room)
west
east
south
north
southwest
southeast
northwest
northeast

3. Have the students read or paraphrase page 138.

4. Let each student choose a source to check - a particular radio station, a newspaper, a TV report (you may wish to have a sign-up sheet so that you will have a record of the source of which each student is responsible).

5. Distribute the charts (Appendix H) and discuss the categories of information. Discuss how each can be recorded and how each aspect of the prediction can be checked. (Students can check some parts - clouds, rain - by direct observation; for others, they may need to listen to a weather summary at the end of the day.)

6. Have students record predictions and weather for three days. Use your newspaper's prediction for the first day. Observe the actual weather with the children and have them record both prediction and observation.

7. After each day have the students bring in their weather prediction and fill in their charts with the predicted weather (from the day before) and the actual weather seen out the window at class time. Some discussion should be made as to time of day weather observations should be made. A summary of the day's weather might be suggested as the best observation of the actual weather.

8. Conclude each day's discussion of their charts by having the students consider the questions on page 139.

9. After 2 days have the students compare their 3 days predictions and actual observations. Collect the charts to be used in a later lesson.

DESIRED LEARNING OUTCOME: The students should be able to describe how models are used to make predictions, and how predictions can be checked for accuracy.

* * *

DEVELOPMENT: 2C-1 Predicting From Models
Page T-246/S-140-141 Weather Map Models (25-35 min.)

PURPOSE: To read and interpret weather map data.

ADVANCE PREPARATION: Materials - enough for each student:
- 1 pencil
- 1 sheet lined paper

TEACHING SUGGESTIONS:

1. Paraphrase pages 140-141.

2. Discuss the three successive weather maps and note how the symbols indicate the movement of the weather fronts.

3. Let the students discuss the italicized questions.

4. Discuss the photograph showing the cold front. Ask students if they have ever experienced sudden, dramatic changes in weather. Explain that these rapid changes usually indicate the passage of a front.

5. Have the students compare the cloud symbols on the two maps on page 140 with the picture of the cold front on page 141.

6. Have each student select one of the cities shown on the three maps and write answers to the numbered exercises on page 141, using the data from the maps.

7. Conclude the lesson by having the students discuss their answers to the numbered questions.

Language Cards/Key Signs
weather map
symbols
Front
cold front
warm front
Montreal
Albany
New York
Boston

Identification Cards

DESIRED LEARNING OUTCOME: The students should be able to read and interpret data from weather maps.

***

APPLICATION: 2C-1 Predicting From Models
Page T-248/S-142 Your Weather Preditions (50 min. over 2 days)

PURPOSE: To apply the concept of predicting from models to predicting the next day's weather.

ADVANCE PREPARATION: Materials - enough for each student:
- 1 pencil
- 1 sheet lined paper
- 1 chart of weather predictions that students made for Recording Your Own Weather earlier in this cluster.

Language Cards/Key Signs
weather chart
weather prediction
temperature
direction
warmer
cooler
wind
cloud cover
record

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by telling the students that up to this time they have been dealing with weather predictions made by others. In this lesson, they are going to make their own predictions.

2. Pass out the charts that the students made for Recording Your Own Weather.

3. Have the students read or paraphrase the lesson on page 142, down to the numbered questions.

4. Discuss each of the lettered questions with the students.

5. Have each student write a prediction for the next day's weather. Have the students use symbols as much as possible.

6. On the following day, discuss the numbered questions at the end of the lesson.

DESIRED LEARNING OUTCOME: Students should be able to make tentative weather predictions based on available data.

* * *

EVALUATION: 2C-1 Predicting From Models
Page T-249/S-143 Predicting From Weather Map Models (35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Reading and interpreting symbols on a weather map.
2. Predicting the next day's weather from weather map information.

ADVANCE PREPARATION: Materials -enough for each student:
- 1 pencil
- 1 sheet lined paper

Language Cards/Key Signs
weather prediction
city
temperature
wind speed
direction
cloudy
rain

Identification Cards

TEACHING SUGGESTIONS:

1. Paraphrase page 143 for the students.

2. Distribute the materials and have the students answer the questions.

3. Go over the students' responses with them when they have completed their work.

4. Collect the papers so that you can evaluate each individual's progress. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

* * *

Level 6 Unit 2 Models

Part C Using Models, Lesson Cluster 2C-2

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-254	Introduction	Reaction Time	30-40 min.
T-255	Development	Measuring Reaction Time	50-75 min.
T-258	Application	Left or Right?	50 min.
T-260	Application	Right and Left Brain	45 min.
T-262	Evaluation	A Final Look at Raaction Time	35 min.

B. MATERIALS: Add the following to the materials list on page T-
-for the next cluster 2C-3, collect recent magazines and newspaper articles dealing with earthquakes and volcanoes (minimum of 3)

FILMSTRIP INFORMATION: Filmstrip Set XIV, Size, Scale and Models, and XIX, Models, are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 2C-2 Models of Human Communication
Page T-254/S-144 Reaction Time (30-40 min.)

PURPOSE: To introduce the concept of modeling the human body's interal communication system, based on reaction time.

ADVANCE PREPARATION:

Background Information: The human organism cannot react instaneously to an outside stimulus. First the brain must process information about the stimulus and devise a suitable response. If, for example, the driver of a car sees an obstruction ahead, there is a measurable time lapse before he or she applies the brakes. During this time, the signal from the eyes travels to the brain, the danger is recognized, and the appropriate response (braking) is selected. Then, another signal must travel from the brain to the foot, directing the action that is to take place. The time between sensing the stimulus and making the response is known as the reaction time.

Language Cards/Key Signs
- internal communication system
- message
- catch the card
- a communication system model
- reaction time
- prediction
- model

Materials -enough for each group:
-1 unlined 7.6 cm x 12.7 cm (3" x 5") file card
-2 pencils
-2 pieces unlined paper
-23 cm x 35 cm (9" x 14")

TEACHING SUGGESTIONS:

1. Demonstrate with one or two students the falling card activity. "Can you catch the card?"

2. Tell the students to work in pairs. Distribute the materials to the students. make sure that they understand what they are to do. Tell them that each pair of partners is to try the experiment. One student is to drop the card four times for the partner to catch. Then the roles of dropper and catcher should be reversed.

3. Discuss with the students why it was difficult to catch the file card.

4. Have the class read or paraphrase for them the first column on page 144 of the student text.

5. Ask the students to draw a model of their eye-hand communication system. The model should attempt to explain the delay in reaction time. If students are not aware of the role of the brain, explain that the brain is the "control center" for all the messages.

6. Conclude the lesson by discussing the numbered questions on page 114 with the class.

DESIRED LEARNING OUTCOME: The students should be able to draw a model illustrating their internal communication system.

****

DEVELOPMENT: Lesson Cluster 2C-2 Models of Human Communication
Page T-255/S-145 Measuring Reaction Time (50-75 min.)

PURPOSE: To develop the model of human internal communication system by measuring reaction time.

ADVANCE PREPARATION:

Background Information: The timers that the students construct for this lesson are based on the principle that objects accelerate or gain speed as they drop. For this reason, the marks on the timer get farther apart near the top of the timer. (Marks for 1, 2, 3, 4, 5, 6, 7, and 9 hundredths are not shown.) We have chosen a 35 cm length because it takes approximately 25 hundredths of a second to drop 30 cm. Most students will be able to react within this time period.

Materials -enough for each group:
- -2 pencils
- -2 pieces unlined paper 23 cm x 35 cm (9" x 14")
- -4 regular paper clips
- -2 rulers, metric 30 cm
- -2 pieces graph paper
- -2 pieces lined paper

Language Cards/Key Signs
reaction time
reaction timer
one-hundredth of a second
test
trial
prediction
the internal communication system
message

Identification Cards
reaction timer
30 cm ruler
graph paper

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the students whether they think that everyone's reaction time is the same. Ask the students whether they think reaction times can be improved by practice.

2. Paraphrase for them, as they perform each task, page 145. Distribute the materials.

3. Have the students follow the directions on page 145 for making their timers. You may wish to copy the chart on the blackboard. Be certain that the students understand that the smaller numbers go at the bottom of their timers, and that the marks get farther apart near the tops of the timers. While the students are working, circulate to give assistance and encouragement as needed. Thus, catching the card 0.8 cm from the bottom gives a fast reaction time of 4/100 second. Catching it at 11 cm from the bottom corresponds to a slower 15/100 second reaction time.

4. Ask the students why they think the paper clips were added to the bottom of the timers (they are weights to make the timers drop straight).

5. Have the children read or paraphrase for them page 146, except for the italicized questions at the bottom of the second column.

6. Let the students discuss the possible results of the test, including the predictions indicated in the text. Have them write down their predictions. Perform 6 tests, more if time permits.

7. Give the students a work plan either on the board or on separate sheets. See example below.

Prediction - Choose one

student 1 = x
student 2 =

A. No change ___
B. Faster ___ ___
C. Slower ___ ___
D. Maybe change later ___ ___ ___

Test of Prediction

Student 1 Test 1- Tries	Student 2
1.	1.
2.	2.
3.	3.
Add to find Total = ________	Add to find Total = ________
Divide total by 3 = ________	Divide total by 3 = ________

Test 2
•
•
•
•
Test 6

Write time results of each test.

Student 1		Student 2
Test 1	____	____
Test 2	____	____
Test 3	____	____
Test 4	____	____
Test 5	____	____
Test 6	____	____

Do the results support your prediction?

Yes	____________	Yes	____________
No	____________	No	____________

8. Pair the students with partners and allow them to conduct their tests. Be certain that the students know that they are to record the result of each trial.

9. Discuss the italicized questions on page 146. Allow the students to converse and compare their results.

10. Paraphrase the first column on page 147. Make copies of the graphs (on page 147) on the blackboard. Let them discuss the meaning of each graph.

11. Have the students plot their own graphs based on the results of their trials. Pass out graph paper. Help them label the vertical and horizontal axes.

12. Conclude the lesson by having the students respond to the numbered questions at the end. (Note : Save the reaction timers for the next lesson.)

DESIRED LEARNING OUTCOME: The students should be able to measure reaction times and relate the results to their models of the human communication system.

****

APPLICATION: Lesson Cuuster 2C-2 Models of Human Interaction
Page T-258/S-148 Left or Right? (50 min.)

PURPOSE: To apply the model of the human internal communication system to the concept of the left or right dominance.

ADVANCE PREPARATION: Materials -for each group:
- -1 reaction timer (Students will need their reaction timers from the preceding lesson)
- -2 pencils
- -2 pieces lined paper
- -2 file cards 7.6 cm x 17.7 cm (3" x 5")

Language Cards/Key Signs
chart
which hand is faster
prediction
test

785

TEACHING SUGGESTIONS:

1. Ask the students why some people write with their left hands while others use their right hands. Encourage them to voice a diversity of opinions.

2. Have the students read or paraphrase for them first paragraph on page 148. While they are reading, distribute the materials for the lesson.

3. Have the students perform tests A, B, and C on page 148. Paraphrase the text directions for them.

4. Let the students predict whether their right or left hands will have the faster reaction time.

5. Have the students read or paraphrase for them the rest of page 148.

6. Tell the students to try the reaction timer several times with each hand, to see which hand has the faster reaction time. Be sure that they record the time for each hand. On the board show the students how to organize their data-trials, average for ten trials.

7. Paraphrase page 149. Copy the blank chart from page 149 on the chalkboard.

	Preferred Side	
	Right	Left
Faster / Right		
Time / Left		

8. Tally the results of the experiment of the chart. (If you prefer, you may tally the results by a show of hands, rather than have each student come up to the board.)

9. Conclude the lesson by discussing the numbered questions on page 149.

DESIRED LEARNING OUTCOME: The students should be able to determine whether they are left or right dominant.

****

APPLICATION: Lesson Cluster 2C-2 Models of Human Communication
Page T-260/S-150 Right or Left Brain (45 min.)

PURPOSE: To apply the model of the human internal communication system to brain, hand, and eye communication.

ADVANCE PREPARATION: Materials -for each student:
- -1 pencil
- -1 sheet lined paper
- -1 reaction timer from previous lesson

TEACHING SUGGESTIONS:

1. Introduce the lesson by having the students read or

Language Cards/Key Signs
class average
communicate
reaction time
prediction
internal communication system model
Sharon's results
Coleman's results
infer
brain
right brain
left brain

paraphrase for them page 150.

2. Write predictions A, B, and C on the blackboard. Ask the students to suggest other possible outcomes.

3. Paraphrase for the students the first column on page 151. Copy (before class) the charts on page 151 on the board or on an overlay.

4. Ask the students to examine Sharon's results, as shown in the list and the table (be sure students understand that both forms present the same information).

5. Discuss the italicized questions at the bottom of column 1, using the results on Sharon's chart.

6. Paraphrase the second column on page 151.

7. Discuss Coleman's results with the class. Have the class discuss the italicized questions in column 2, using Coleman's results. Go over the results of the class average table.

8. Have the class answer the numbered questions at the bottom of page 151.

9. Conclude the lesson by having the students discuss ways in which their findings would lead them to modify their human internal communication system models. (Pathways for messages from the right eye should go to the left side of the brain; messages to the right hand should come from the left side of the brain; and so on. It will be apparent that, in some cases, one side of the brain must send a message to the other side.)

DESIRED LEARNING OUTCOME: The students should be able to differentiate between actions controlled by the left and right sides of the brain and to incorporate these data in their internal communication models.

****

EVALUATION: Lesson Cluster 2C-2 Models of Human Communication
Page T-262/S-152 A Final Look at Reaction Time (35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Drawing a model for the internal human communication system.
2. Using the model to estimate relative speeds of reaction times.

ADVANCE PREPARATION: Materials -for each student:
-1 pencil
-1 piece of lined paper
-(do you have magazine articles of volcanoes and earthquakes for Cluster 2C-3? Post up in room now)

TEACHING SUGGESTIONS:

1. Draw on the board or make copies and distribute an outline of the human body. Tell the students that they are to answer the questions by drawing a line to different parts of the body. Each line should be numbered with the question #. (A written or verbal description should also be given.)

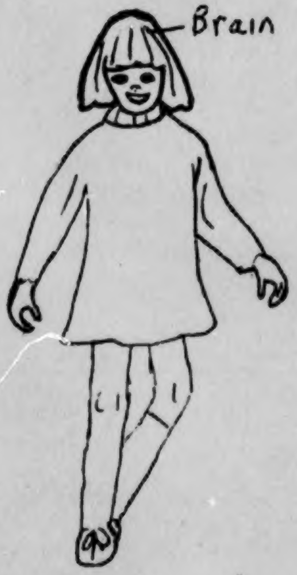
2. Paraphrase page 152.

3. Be sure that the students understand what they are to do.

4. Distribute the materials and have the students do the lesson.

5. Go over the students' responses with them when they have completed their work. You may wish to let the students correct their own papers to enable them to evaluate their own progress.

6. Collect the paper so that you can evaluate each individual's progress. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.



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Level 6 Unit 2 Models

Part C Using Models, Lesson Cluster 2C-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-268	Introduction	A Model of the Earth	35 min.
T-269	Development	An Earthquake Prediction Model	50 min.
T-270	Development	Volcanoes and Earthqukes	50 min.
T-272	Application	Detecting Earthquakes	50 min.
T-276	Evaluation	Predicting With Models	40 min.

B. MATERIALS: Add the following materials to the list on page 264
Find a few pictures of earthquake damage in magazines, encyclopedias, science texts, etc. (for lesson 4).
Dish of cold jello in large shallow pan. (optional for lesson 4)

FILMSTRIP INFORMATION: Filmstrip Set XIV, Size, Scale and Models, and XIX, Models, are appropriate for use in this unit.

INTRODUCTION: 2C-3 Models of Earthquakes and Volcanoes
Page T-268/S-153 A Model of the Earth (35 min.)

PURPOSE: To use models to study earthquakes and volcanoes.

ADVANCE PREPARATION: Materials - Collect recent magazine articles dealing with earthquakes or volcanoes. A minimum of three is desirable. Display the articles on the bulletin board, so that the students may read them at their convenience.
- 2 blocks of wood to demonstrate faults

Language Cards/Key Signs
fault
erupt
earthquake
volcanoes

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by calling the students' attention to the articles. Ask several students to tell what they know about earthquakes or volcanoes.

2. Have the class read or paraphrase for them page 153 down to the numbered questions.

3. Write the words fault and erupt on the chalkboard. Make certain that the students understand these words. Demonstrate fault activity with blocks of wood moving up, down and sideways.

4. Explain that when we speak of rock moving along a fault, we are not referring to a pebble or even a giant boulder. Rather, a whole section of rock that makes up the Earth is moving. The section may be kilometers or even hundreds of kilometers long.

5. Conclude the lesson by using the numbered questions on the page to stimulate and direct class discussion.

DESIRED LEARNING OUTCOME: The students should be able to state that earthquakes are caused by movement in the Earth's crust.

****

DEVELOPMENT: 2C-3 Models of Earthquakes and Volcanoes
Page T-269/S-154 An Earthquake Prediction Model (50 min.)

PURPOSE: To develop a model showing the pattern of earthquake occurences.

ADVANCE PREPARATION: Materials - enough for each student
- 1 Locating Earthquakes, Appendix 1
- 1 blue colored pencil (red may be used)
- 1 globe (optional)

Background Information - As mentioned in the preceding lesson, earthquakes tend to occur along faults in the Earth's crust. In this lesson students make a model that shows where earthquakes have previously occurred. The pattern of quakes shows the location of some major faults, and therefore indicates where future quakes may happen. The circle of earthquakes and volcanic activity that runs up the west coast of South America to California and Alaska, then down the coast to Asia to the Philippines is known as the "Ring of Fire." About 80 per cent of the world's earthquakes take place along this line.

Language Cards/Key Signs
earthquake prediction table
longitude
latitude
Is there an earthquake pattern?
What must the earth's crust be like?
locating earthquakes map
earth's crust
pattern

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by asking the class if they can think of reasons why it would be useful to know where earthquakes might occur.

2. Paraphrase page 154 as far as the numbered questions.

3. Distribute the materials.

4. Demonstrate how to plot each earthquake site in latitude (N or S) and longitude (E or W). Show location on the map and in a globe.

5. Have the students plot the locations from the table on their maps. Meanwhile, circulate and provide assistance where needed. Stop when the first group plots all 52.

6. Discuss the numbered questions on page 154 with them. Have the students share their maps with each other. Be certain that the students retain their models, since they will need them again for the next lesson.

DESIRED LEARNING OUTCOME: The students should be able to make a model indicating earthquake locations and identify this model as a map of major fault zones.

****

DEVELOPMENT: 2C-3 Models of Earthquakes and Volcanoes
Page T-270/S-155 Volcanoes and Earthquakes (50 min.)

PURPOSE: To develop the concept that volcanoes are connected with earthquakes by plotting volcano locations on the earthquake model developed in the last lesson.

ADVANCE PREPARATION: Materials - enough for each student:
- 1 outline map from previous lesson
- 1 pencil of different color from previous lesson

Language Cards/Key Signs
locating earthquakes map
make a model
connecting
volcanoes and earthquakes
volcano
earthquake
earth's crust

Identification Cards

TEACHING SUGGESTIONS:

1. Ask the class whether they think there is any connection between earthquakes and volcanoes.
2. Have students read or paraphrase for them page 155 and down to the numbered questions.
3. Write on the board one additional volcano, Mt. St. Helens, latitude 46 N and longitude 123 W. Distribute the materials.
4. Let the students plot the locations of the volcanoes on their earthquake maps. While the class is working, circulate and give assistance as needed.
5. When the students have finished with their maps, discuss the numbered questions with them.

DESIRED LEARNING OUTCOME: The students should be able to identify a geographical connection between earthquakes and volcanoes on their models.

****

APPLICATION: 2C-3 Models of Earthquakes and Volcanoes
Page T-272/S-156 Detecting Earthquakes (50 min.)

PURPOSE: To apply standardized models to measuring the magnitude or intensity of earthquakes.

ADVANCE PREPARATION:
1. Find a few pictures of earthquake damage in magazines, encyclopedias, science texts, etc.
2. Dish of cold jello in large shallow pan (optional).

Language Cards/Key Signs
detecting earthquakes
million
intensity
earthquake magnitude
seismograph
Richter Scale
Modified Mercalli Scale

Identification Cards

791

Background Information - This lesson discusses two models that are used to measure earthquakes, the Richter Scale and the Modified Mercalli Scale.

The Richter Scale measures the magnitude of an earthquake, as calculated from seismograph readings. This scale uses numbers from 1 up. Each number on the Richter Scale indicates an earthquake ten times stronger than the number below it. A quake that measures 7 or more on the Richter Scale is considered major.

The second model for describing earthquakes is the Modified Mercalli Scale. This scale measures intensity rather than magnitude. The measurement of intensity is subjective, based on descriptions by people who experiences the quake. The Modified Mercalli Scale indicates the extent of damage and loss of life that result from an earthquake.

TEACHING SUGGESTIONS:

1. Have the students read or paraphrase for them the first paragraphs on page 156, down to the example of the graph made by the seismograph. Discuss with the students how the seismograph works. The pen is attached to a rod buried in the ground. The paper is laying on a table in a room. When the ground moves the rod and the paper move, the pen attached to a heavy arm tends to remain stationary (due to its inertia). This is a simple example. Today magnification of movement is done through electronic devices. Each high peak represents an earthquake shock passing the site. Demonstrate by shaking a dish of cold jello (optional). See figure 1.

2. Using the blackboard or a piece of wood and colored felt pens, draw earth layers. Relate ideas in the first paragraph to this drawing. See figure 2.

3. After the class has read or you have paraphrased the rest of page 156, explain that the Richter Scale and the Modified Mercalli Scale are models for describing earthquakes. Ask why such models are useful to scientists. (These standardized descriptions give scientists a way to compare one earthquake with another. Accurate measurement and description is important in all scientific fields.)

4. Have the students read page 157, the models in the Modified Mercalli Scale. While they are reading put a simplified version of the Mercalli Scale on the board (i.e. 1 - not felt, etc.). Discuss the progression of damage indicated by the different intensities and point out that subjective views may result in different interpretations.

5. Conclude the lesson by having the students examine the photographs on pages 158 and 159 and answer the numbered questions.

6. Show pictures of other earthquake damage and have students determine intensity.

DESIRED LEARNING OUTCOME: The students should be able to assign Modified Mercalli Scale intensity numbers to earthquakes whose results they see in pictures.

****

Figure 1. Simplified Seismograph

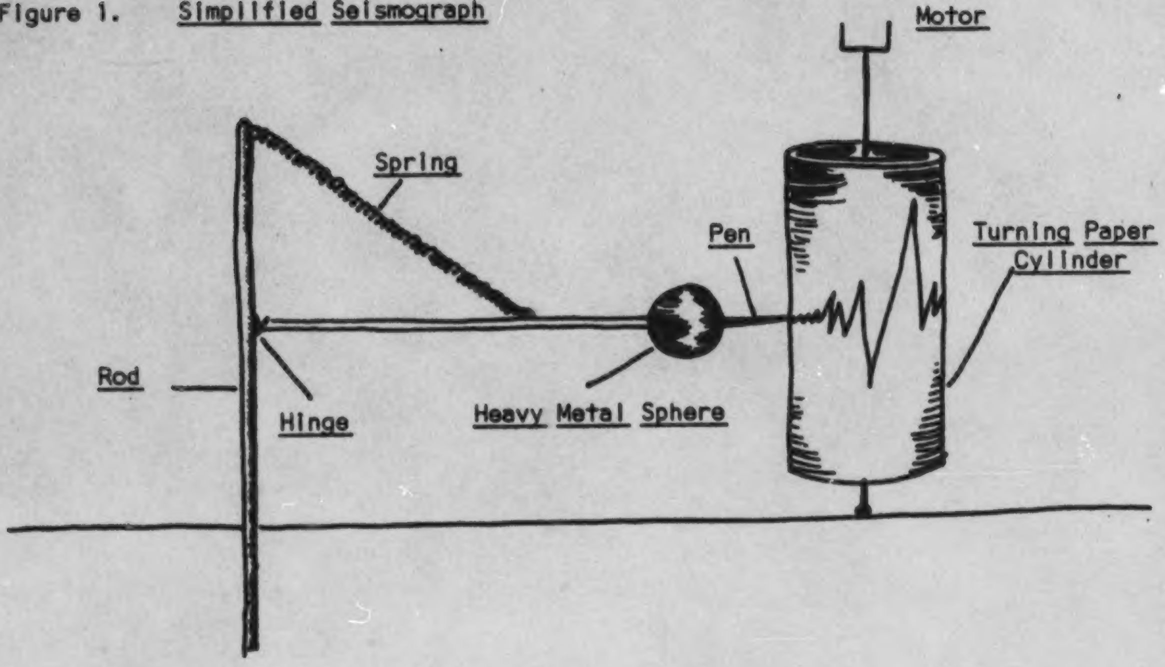
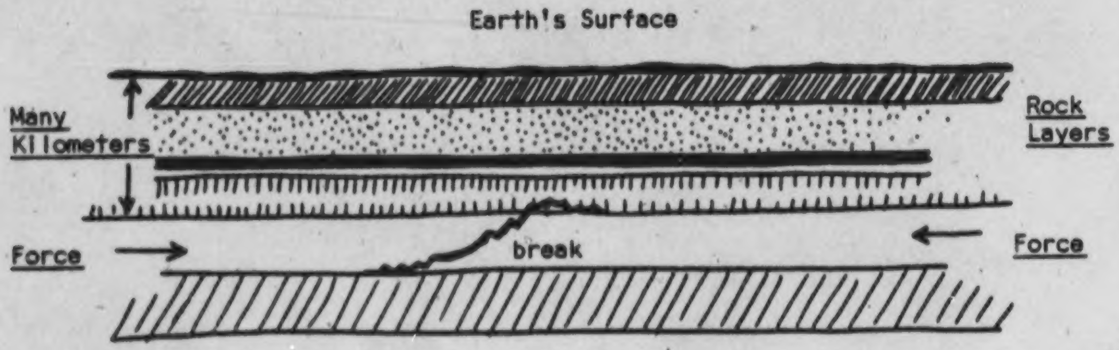

Motor
Spring
Pen
Turning Paper Cylinder
Rod
Hinge
Heavy Metal Sphere

Figure 2. Earthquake


Earth's Surface
Many Kilometers
Rock Layers
Force
break
Force

EVALUATION: 2C-3 Models of Earthquakes and Volcanoes
Page T-276/S-160 Predicting With Models (40 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Defining a fault in the Earth's crust.
2. Interpreting a seismograph reading.
3. Describing the intensity of an earthquake according to the Modified Mercalli Scale.

ADVANCE PREPARATION: For each student - 1 pencil
1 sheet lined paper

Language Cards/Key Signs
fault
earthquake
volcano
predic

Identification Cards

TEACHING SUGGESTIONS:

1. Paraphrase the question to the students. Tell them you will be changing two of the questions given in the book.

Question 1A	Define or draw a fault.
Question 1B	What makes the wavey line shown by a seismograph?
Question 1C	Copy the imaginary island country shown on the board. The circles show the location of volcanoes. Predict where the next 5 earthquakes will occur in this imaginary country. (The earthquakes should be positioned along the line of volcanoes.)
Question 2	How many sharp earthquake shocks are shown in the seismograph reading on page 160.
Question 3	(remains the same as indicated on page 160.)

2. Distribute the materials and have the students do the lesson.

3. Go over the students' responses with them when they have completed their work. You may wish to let the students correct their own papers to enable them to evaluate their progress.

4. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

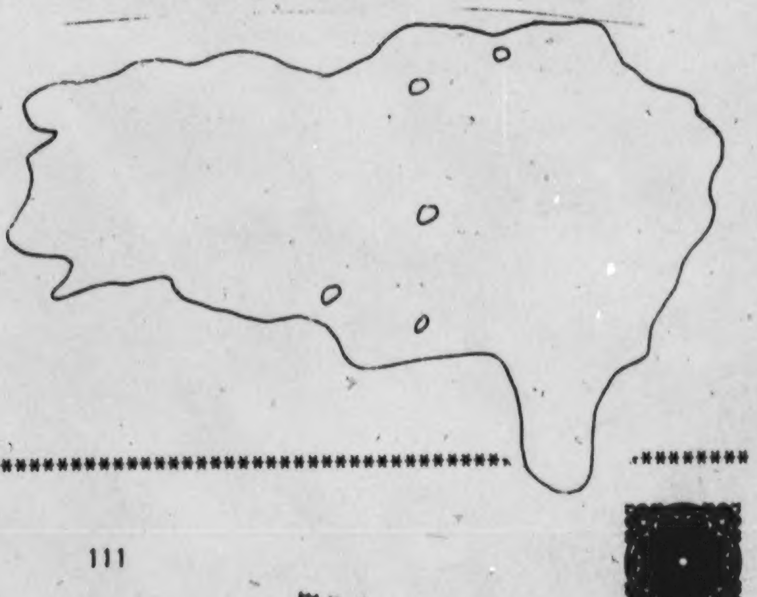


Figure 1. Country of Island

* * *

Level 6 Unit 3 Models of Matter

Part A More Than One Model, Lesson Cluster 3A-1

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-288	Introduction	A Secret Object	60 min.
T-289	Development	What's Inside?	60 min.
T-290	Application	Circuit Puzzle	60 min.
T-292	Evaluation	Puzzles to Solve	60 min.

B. MATERIALS: Add the following materials to the list on page T-285:
-Scoot system rectangle dittoes
-Circuit puzzle dittoes
-Circuit puzzle chart dittoes

FILMSTRIP INFORMATION: Filmstrip Set XVIII, Invisible Systems, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3A-1 Inferring from Models
Page T-288/S-166 A Secret Object (60 min.)

PURPOSE: To develop a model of the shape and relative size of a solid object in a box, using indirect evidence.

ADVANCE PREPARATION:

Background Information: This lesson focuses on how to gather information about an unknown object. Students do not know the identity of the object. Instead, they collect observations and then infer a model of the object. This is the same principle that scientists use when they study atoms, stars, or other objects that cannot be worked with directly.

Begin collecting the boxes two to three days before the activity. Ask students to bring them in, or you can use the boxes from the Scoot Systems, page 119. Set aside one hard object of each kind as an example. Put each of the remaining 15 objects in a shoe box. Put the lid on each box and number code it so that you know what is inside; e.g., pieces of chalk could be in the boxes labeled #1, and spools in the boxes labeled #2. Put a different item, such as a small toy car with free rolling wheels, in another box to use as a demonstration.

Language Cards/Key Signs
object
system
interaction
inference
infer
model
properties
size and shape

TEACHING SUGGESTIONS:

1. Begin the activity by paraphrasing for the students page 164.

2. Show the students the box containing the object you have chosen for the demonstration. Hold covered box in front of you. Move it in different directions. Feel

sides of the box with your hands as you move it. Turn around, back towards students, box behind you. Then, remove box lid, and feel object(s) carefully with hands. Replace objects in box, put lid back on. Turn around to face students.

3. Give one student a covered box. Encourage student to move box and feel outsides as it moves. Then take box, walk behind student, take lid, and place student's hand(s) in box. Student should feel item(s). Next, encourage students to return object(s) to box. Replace lid on box. Move in front of student. List student's observations about object on board in a column labelled "A."

4. Ask student to draw object on board. Label drawing "B" and show students item(s) in box.

5. Repeat process with another box with another student.

6. Pass out boxes to pairs of students. Have one student stand behind seated partner. This student will hold box for partner and will remove and replace lid. Collect boxes.

7. Seated students should make an "A" observations list and a "B" drawing. Show students items in boxes.

8. Give each pair of students another box and repeat process with the other partner.

9. Paraphrase paragraph 1, page 164 again.

10. Have students read and answer question 1.

DESIRED LEARNING OUTCOME: The students should be able to develop a model of a hidden object from indirect evidence.

****

DEVELOPMENT: Lesson Cluster 3A-1 Inferring From Models
Page T-289/S-165 What's Inside? (60 min.)

PURPOSE: To develop a model of a hidden structure from indirect evidence.

ADVANCE PREPARATION:

Background Information: Although this activity is similar in purpose to the preceeding one, the teaching method is different. The students should not be given any clues.

Stress the need for the students to draw each aspect of their proposed model, showing sizes and positions of the partitions. As students manipulate the boxes, they may change their minds as to partition placement. This is good. As new evidence is found, the models should change to fit the new evidence. Emphasize this flexibility to the students as they proceed.

Before the class period, cut the pieces of cardboard into squares and rectangles of various sizes that will easily fit into the shoe boxes.

Language Cards/Key Signs
system
Scoot System
cardboard
marble

Identification Cards
shoebox
cardboard

TEACHING SUGGESTIONS:

1. Introduce the activity by telling the students that they have another opportunity to develop a model, only there will be little if any help from you. They are to

be on their own as much as possible.

2. Paraphrase directions on page 165. Ask students to read page 165.

3. Build one box in front of the students. Use just one or two partitions. Put in a metal ball. Tape shut.

4. Pass box around. Encourage students to move it in different ways.

5. Pass out Scoot System rectangle dittoes. Ask students to draw partitions as they think they are located. Then open up box and show it to them.

6. Let the students work in pairs and follow the directions on page 165. Give students no more than two partitions. By the end of the activity, each student should have a sketch of the partitions within the box.

7. While the students are working, move around the class and encourage them to visualize their models by asking questions such as, "Does the marble roll all the way to the end? If not, where does it stop or change direction? How would that look in the box? Now, draw it."

8. When they have had enough time, tell the students to open the box and sketch the actual partitions next to their model.

9. Have students show their boxes to other students.

DESIRED LEARNING OUTCOME: The students should be able to develop a model of a hidden structure within a box from indirect evidence.

****

APPLICATION: Lesson Cluster 3A-1 Inferring From Models
Page T-290/S-166 Circuit Puzzle (60 min.)

PURPOSE: To show that more than one model may explain a set of observations.

ADVANCE PREPARATION:

Background information: Objects such as wires and aluminum foil conduct electricity. Objects such as paper do not. Students will be given a circuit puzzle made of pieces of aluminum foil and paper. Using a tester made of a battery, wires, and small bulb, they are expected to develop a model of the inside of the circuit puzzle. Their model must explain why the bulb lights when certain parts of the puzzle are connected but not when other parts are connected.

This activity was developed by Dr. Richard J. McLeod of Michigan State University and is used with his permission.

Materials
- make two circuit puzzles whose aluminum foil is exposed on the back
- make overhead overlay of chart on p. 166
- ditto copies of chart on p. 166

Language Cards/Key Signs
interact
aluminum foil
wires
battery
circuit
puzzle
bulb
model
combination
connections
What happens?
Draw a model

Identification Cards
aluminum foil
battery
circuit puzzle
bulb

TEACHING SUGGESTIONS:

1. Demonstrate attaching wires.

2. Pass out batteries and assist students in attaching wires.

3. Demonstrate touching aluminum foil to wires.

4. Pass out aluminum foil and assist students in using it to light bulb.

5. Pass out paper and ask them to test it.

6. Ask students to read page 166, column 1. Review answers to questions.

7. Show students a circuit puzzle. Light bulb by touching wires to it. Then turn over demonstration puzzle and show them aluminum foil on the back. Repeat with a puzzle with a different aluminum foil pattern.

8. Use overhead overlay of chart on page 166. Light bulb using the first sample circuit puzzle. Then ask a student to indicate which holes you used. Write "yes" in appropriate block on chart. Then try another pair of holes. Fill in appropriate block. Continue until all combinations are tested.

9. Ask students to read page 166-167 (column 1). Pass out charts to students. Point out that the backs of their puzzles are covered. Ask them to try to light their bulbs. When they have tried one combination, assist them in filling out their charts. Repeat until all appropriate blocks are filled out.

10. Ask students to draw what they think the back of their circuit puzzle looks like.

11. Can they draw another way it might look?

12. Optional: Trade circuit puzzles among student. See what drawing they develop. Do we have different ideas about how the back of a particular puzzle might look?

13. Ask students to read questions in column 2, page 167. Work with class on questions.

14. Uncover backs of students' circuit cards so students compare their model with actual card.

DESIRED LEARNING OUTCOME: The students should be able to develop more than one model of a circuit puzzle to explain the data they collected.

****

EVALUATION: Lesson Cluster 3A-1 Inferring From Models
Page T-292/S-185 Puzzles to Solve (60 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Making inferences from indirect evidence.
2. Building models based on inferences.
3. Identifying the extent to which certain models are successful.
4. Predicting events based on specific models.

ADVANCE PREPARATION: Materials -ditto with six rectangles like the one shown in column 2, page 185
-circuit puzzle that will light as does the one described on page 168

TEACHING SUGGESTIONS:

1. Direct students to open their text to page 168, read the page, and answer questions 1 through 5, giving them adequate time to match the items as directed. Paraphrase and act out each question as necessary. Review their matches before proceeding with the circuit puzzle.

2. Give students ditto with circuit puzzle forms on it.

3. Light bulb using circuit puzzle as per example on page 168.

4. Ask students to read top half of column 2, page 168 and question 6.

5. Ask questions 7 and 8.

6. Ask students to read questions 9 and 10 and answer them. Then, demonstrate circuits listed in questions 9 and 10 so that students can receive concrete feedback on whether their answers were correct.

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Level 6 Unit 3 Models of Matter

Part A More Than One Model, Lesson C-luster 3A-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-298	Introduction	What is a Mixture?	40-50 min.
T-299	Introduction	The Push Model	50-60 min.
T-300	Development	Predicting With the Push Model	60 min.
T-301	Application	Hot and Cold	60 min.
T-302	Application	Large and Small	60 min.
T-304	Application	The Shake Model	60-75 min.
T-306	Evaluation	More Models	50-60 min.

B. MATERIALS: Add the following materials to the list on page 295 -

- ditto and overhead overlay of chart on page 177
- two instant drink mix powders, including one grape flavor
- two pitchers
- spoon
- two materials that do not mix well together (e.g. oil and water)
- six glass jars
- teaspoon

FILMSTRIP INFORMATION: Filmstrip Set XVIII, Invisible Systems, is appropriate for use in this unit.

INTRODUCTION: 3A-2 Models of Mixing Systems
Page T-298/S-169 What is a Mixture? (40-50 min.)

PURPOSE: To introduce the concept of mixture.

ADVANCE PREPARATION: Materials
- two instant drink powders, one grape and one other flavor
- small paper cups
- spoon
- water
- two materials that do not mix well together (e.g. oil and water)
- 2 pitchers or bowls

Language Cards/Key Signs
This is a mixture.
What will happen?
What will the properties be?
property
mixture
predict
combination
materials
mixing system
powder

Identification Cards
mixture
drink powder

800

Background Information - Mixtures and compounds are different. A mixture consists of two or more substances that combine without losing their individual identities. In a compound, the identities of the combining substances are changed. For example, in a mixture of salt (sodium chloride) and water, the salt still exists as sodium chloride and the water as water. If the water evaporates, the salt is left behind. But when pure sodium combines with water, a new compound, sodium hydroxide (caustic soda), is formed.

Mixtures possess some of the properties of the combining substances; compounds do not. For example, a mixture of blue food coloring and water will be blue and watery. But the compound sodium chloride (salt) is not at all like sodium (a metal) or chlorine (a deadly gas).

Mixtures can be made of solids, liquids, and gases. The oceans are mixtures of water and many dissolved solids. The atmosphere is a mixture of oxygen, nitrogen, carbon dioxide, and other gases.

TEACHING SUGGESTIONS:

1. Mix a drink powder (not grape) with water in front of students. Label with identification card.

2. Ask students to describe what you did. Give each student a taste.

3. Ask students to look at picture on page 169.

4. Paraphrase page 169. Then have students read it.

5. Hold out grape drink packet. Paraphrase question 1, page 169. After students have given their ideas, ask one student to help you mix the powder with water. Ask another student to help you pour grape drink into cups and pass them out to other students. Were their ideas correct about what the properties of the mixture would be?

6. Repeat process in #5 using two materials that do not mix together.

7. End the discussion with the idea that it isn't obvious why some substances will mix and others will not. There is more to making mixtures than meets the eye.

DESIRED LEARNING OUTCOME: The students should be able to give several examples of mixtures and predict some properties of mixtures from the properties of their ingredients.

****

INTRODUCTION: 3A-2 Models of Mixing Systems
Page T-299/S-170 The Push Model (50-60 min.)

PURPOSE: To determine whether the push model provides a good explanation for a mixture.

ADVANCE PREPARATION: Materials - glass jars
- teaspoons

Background Information - One might say that the initial "push" of the drop of food coloring, as it strikes the water and falls through it, begins the mixing. Afterwards, as the wisps of coloring slowly spread throughout the water, students may infer that the coloring and water are still pushing on each other. But all they can actually observe is movement, not pushing. Do not dispute their claim that the liquids are pushing each other. Instead, ask what their evidence is (observed movement of coloring) and what could be causing the pushing (not readily apparent). Do not attack or defend the push model, but help the students to see that while it seems at least partially satisfactory, it may not explain all their observations.

Language Cards/Key Signs
What do you observe?
Push model
model
mixing
observe
material
liquid food coloring
support
evidence

Identification Cards
cup
liquid food coloring

TEACHING SUGGESTIONS:

1. Fill a glass jar with water. When water is still, drop a half teaspoon of food coloring into it. Have students gathered around jar. Label with the time of day. Have another jar started before school begins. Encourage them to watch closely. Ask them to indicate what they saw. Do another jar every half hour. Label each with the time. This will enable students to see the progression of mixing without sitting and watching the same jar for two hours. A time line of jars can be set up. Students could then easily also see stages of change in mixing.

2. Paraphrase column one, page 170. Then ask students to read it.

3. Have each student label a cup with his/her name and fill it with water.

4. Instruct students to add the food coloring after the water has had a few minutes to become still. Warn them to avoid getting the color on their clothing.

5. Have them observe cup at 10 minute intervals. Later, have them draw what happened.

6. Paraphrase questions in column two and ask students what they think about them. Keep in mind that this is an exploratory activity that is not expected to lead to final acceptance or rejection of the model.

7. Have the students examine the mixtures for the next three days. At the end of this time, ask if the push model provides an explanation for why the water and food coloring have stayed mixed and not separated.out. The answer: apparently not.

DESIRED LEARNING OUTCOME: The students should be able to partially explain the mixing of food coloring and water in terms of the push model and determine which evidence may not fit the model.

****

DEVELOPMENT: 3A-2 Models of Mixing Systems
Page T-300/S-171 Predicting With the Push Model (60 min.)

PURPOSE: To make and test predictions based on the push model.

802

ADVANCE PREPARATION: Materials - plastic cups
- medicine droppers
- containers of dark food coloring
- grease pencils
- meter sticks
- paper and pencils
- water

Language Cards/Key Signs
predicting
model
food coloring
height
surface
prediction

Identification Cards
food coloring
cup

Background Information - A model is useful if correct predictions can be made based on the model. According to the push model, the pushing of one substance against the other causes mixing. Therefore, the farther the drop of food coloring falls before it hits the water, the better the mixing should be. In fact, what happens is that there is more turbulence and mixing when the food coloring is dropped from greater heights, but only at first. After the initial disturbance, mixing proceeds as it did in the preceding activity, by slow diffusion.

TEACHING SUGGESTIONS:

1. Review the push model.

2. Paraphrase each paragraph on page 171. After each is paraphrased have students read it.

3. Write down student predictions on the board.

4. Have students make a chart for their observations.

5. Caution students to avoid getting food coloring on their clothing.

6. Have students work in groups of two with seven cups.

7. Ask the students to give the water in the cups a few minutes to become still before they add the food coloring.

8. Should students inquire what "mixing better" means, suggest that they try to determine how completely the color spreads throughout the water or how fast the color spreads.

9. Following the activity, discuss the predictions and observations. Each student should make a judgment about the value of the model in accurately predicting results.

DESIRED LEARNING OUTCOME: The students should be able to explain how successfully the push model predicts the results of mixing experiments.

****

APPLICATION: 3A-2 Models of Mixing Systems
Page T-301/S-172 Hot and Cold (60 min.)

PURPOSE: To test the push model of mixing when the ingredients are at different temperatures.

ADVANCE PREPARATION: Materials
- plastic cups
- medicine droppers
- containers of dark food coloring
- grease pencils
- containers for water

Background Information - The push model may partially explain why materials mix when they are at the same temperature, as in the two preceding activities. But the push model says nothing about temperature mixing. If a small amount of hot liquid is dropped in cold liquid, the warm liquid will tend to float and therefore not mix as well as when the liquids are at the same temperature. The push model does not explain these observations.

A fair test, which the students will carry out, is a controlled experiment. To do a fair test, use two or more set-ups that are identical except for the variable you are testing. Only by doing a fair test can you be certain of the variable causing an observed effect.

Language Cards/Key Signs
push model
What do you think would happen?
What do you observe?
liquid
temperature
difference
evidence
food coloring
fair
immediately
observe
compare

Identification Cards
heated food coloring
cool food coloring

TEACHING SUGGESTIONS:

1. Paraphrase column one, page 172. Have students give predictions. Write them on chalkboard.

2. Have students read column one, page 172.

3. Discuss the nature of a fair test as described in the BACKGROUND INFORMATION. Ask students to be careful to have the dropper only slightly above the water when dropping the food coloring in. The idea is to give the system only a small "push" this time and to have the "push" from falling the same in both cases, leaving temperature only as a variable.

4. Paraphrase column two, page 172 down to question D. Ask students to read this section.

5. Divide students into groups of two. Ask them to perform tests.

6. After activity, list student observations on chalkboard.

7. Paraphrase questions 1 and 2, column two, page 172. Then have students read questions. Challenge students who are reluctant to give up the push model to try to adapt it to fit the new evidence. They may be able to add a temperature factor. Some students will willingly develop their own new model.

DESIRED LEARNING OUTCOME: The students should be able to amend the push model to fit new evidence or develop a new model.

* * *

APPLICATION: 3A-2 Models of Mixing Systems
Page T-302/S-173 Large and Small (60 min.)

PURPOSE: To test the usefulness of the push model in explaining how substances of different sizes dissolve.

ADVANCE PREPARATION: Materials - Have ready for each student:
- 2 plastic cups
- 2 pieces of hard candy

Background Information - Dissolving is the form of mixing in which a gas or solid mixes with a liquid. Be sure the class understands this.

Small pieces of candy will dissolve (mix) faster in water than larger pieces, because the small pieces expose more surface area to the water. The students do not, of course, understand the reason for this phenomenon, and it would defeat the purpose of the lesson to explain it to them.

When a drop of food coloring falls into the water, some initial mixing is evident and can be partially explained by the push model. That will not be the case with the candy and water. The large and small pieces will reach the bottom of the cups equally fast and equally undissolved. Pushing here seems ineffective. After a while, however, students will observe a colored cloud of dissolving candy forming around the pieces. They may infer that the candy is pushing out into the water. Be sure to point out that this is an inference, not an observation. Ask what could be causing the push, if it is one. The students will probably not have any idea.

Language Cards/Key Signs

push model
What do you predict?
dissolve
candy
crush
model
predict
fair
solid
observation

Identification Cards

whole candy
crushed candy

Support that class in feeling there is an on-going mystery here that future lessons will help them solve. Doing this series of activities leading up to the small particle model will give the students a much better understanding of that model than they could gain if it were presented to them at the start as the accepted model of matter.

TEACHING SUGGESTIONS:

1. Review push model.

2. Paraphrase paragrpahs 1-3, page 173. List student responses on chalkboard.

3. Ask students to read page 173. Paraphrase paragraph describing fair test.

4. Half fill cups with water. Ask students to place two cups on shelf or windowsill, label a piece of paper with their name and place label by their cups.

5. Crush a piece of candy on a paper towel and give it and a piece of whole candy to a student. Ask him/her to drop whole piece into a cup, crushed pieces into another cup. Repeat process with each student. Caution them not to stir water.

6. Ask students to observe what occurs in cups.

7. Work with students on questions 1-3, page 173.

DESIRED LEARNING OUTCOME: The students should be able to amend the push model to fit the new evidence or develop a new model.

****

APPLICATION: 3A-2 Models of Mixing Systems
Page T-304/S-174 The Shake Model (60-75 min.)

PURPOSE: To introduce the shake model and test predictions based on it.

ADVANCE PREPARATION: Materials - medicine droppers
- containers for water

Background Information - In the first part of the activity, students will find that the faster they shake a salt and water mixture, the better the two will mix. However, in the next part of the activity, they will find that the length of time they shake salt with water may not affect how much salt dissolves. The water will probably become saturated with salt and be unable to dissolve any more no matter how long it is shaken. Therefore, the shaking model does not explain all the observations on mixing. Since a successful model should be able to explain the available evidence and also provide correct predictions, the shake model is not a wholly successful model. When a scientific model does not explain the phenomena it is supposed to, it must be modified or abandoned.

Language Cards/Key Signs
shake model
What happens?
materials
mix
predict
label
dissolve
salt
container
medicine dropper
different
interpret
results
observation

Identification Cards
salt
medicine dropper
container

TEACHING SUGGESTIONS:

1. Introduce this activity by reviewing how to determine when a model is successful.

2. Paraphrase page 174. Ask them to predict whether mixing will occur better if shaking is faster?

3. Ask students to read page 174.

4. Divide students into groups of three and do activity as suggested on page 174. Emphasize the nature of a fair test. If, for example, the students are testing the effect of how fast they shake the mixture, then the vials must be the same size, the amount of salt and water in all containers must be the same, and a "shake" should be defined and understood by all students to be the same motion (most likely one shake would be one back-and-forth motion).

5. Ask students to label containers A, B, and C. Discuss differences they observed. List differences on chalkboard.

6. Paraphrase page 175, paragraphs 1 and 2, then ask students to read this section.

7. Ask students to do activity on page 175 in their groups.

8. Ask students to label containers A, B, and C. Discuss differences observed. List on chalkboard.

9. Paraphrase and work through questions 1-6, page 175 with students.

DESIRED LEARNING OUTCOME: The students should be able to evaluate the shake model in terms of how well it enables them to predict results.

****

EVALUATION: 3 A-2 Models of Mixing Systems
Page T-306/S-176 More Models (50-60 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Evaluating how well four models explain mixing.
2. Stating evidence that supports their evaluations.

ADVANCE PREPARATION: Materials - ditto of chart on page 177
- overhead overlay of chart on page 177

Language Cards/Key Signs
push model
shake model
sticky model
small particle model
model
system
successful
food coloring
interaction
mixing model
developed
unstick
movement
material
rate

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing the features of the push and shake models.

2. Paraphrase page 176 then have students read page 176.

3. Make a list on the chalkboard of all the models, including the two new models introduced in this lesson. Discuss these models to be sure the students understand them. You could choose one activity the students have done and discuss how well each of the four models explains the results. If students have developed their own models, include these on the list, too. The next cluster will work with all models, so students will have opportunity for development of greater understanding.

4. Paraphrase page 177. Pass out dittos of chart on page 177. Ask students to read page 177. Do food colorings model on overhead overlay of chart.

5. Ask students to do #1, page 177.

6. Work with students on questions 2, 3, page 177.

****

Part A More Than One Model, Lesson Cluster 3A-3

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-312	Introduction	How Do Solids Mix With Liquids	50-60 min.
T-313	Introduction	Slow Motion Mixing	30-40 min.
T-314	Development	Unmixing Mixtures	60 min.
T-317	Application	Mixing Paint	30-45 min.
T-318	Evaluation	The Amazing Gotton Ball	50-60 min.

NOTE: The Enrichment lesson has been eliminated.

B. MATERIALS: Add the following to the list on page T-309:
-1 tube each of blue and white artist's paint
-artist's paint brush

FILMSTRIP INFORMATION: Filmstrip Set XVIII, Invisible Systems, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3A-3 Models of Mixing and Unmixing
Page T-312/S-178 How Do Solids Mix With Liquids? (50-60 min.)

PURPOSE: To apply the previously introduced models of mixing to a new mixing interaction.

ADVANCE PREPARATION:

Background Information: There is no one answer for this lesson or for Lesson (1b). In both lessons the substances will mix. However, the push model and the shake model are not likely to adequately explain the results. There is little apparent pushing in either of these activities (unlike the pushing that might have been inferred when food coloring was dropped from increasing heights); nor is there any apparent shaking. The sticky model is also weak in predicting mixing in Lesson (1b), because it is difficult to visualize how the rather rigid gelatin is going to unstick the food coloring. The small particle model is the one most likely to explain mixing in both lessons, because it states that particles of matter are always moving. However, do not expect this same reasoning from the students. While they may accept the idea that fruit drink powder is made up of small particles, the students will not intuitively accept the idea that water and gelatin are, too. Any model the students choose is acceptable as long as they explain the results adequately in terms of their model.

Language Cards/Key Signs
- What happens?
- small particle model
- push model
- shake model
- sticky model
- models
- mixing
- interaction
- coffee stirrer
- estimate
- observations
- evidence
- solid
- liquid

Identification Cards
- coffee stirrer
- cup
- fruit drink powder

Materials -clear plastic cups
-coffee stirrers or popsicle sticks
-containers for water
-powdered fruit drink

TEACHING SUGGESTIONS:

1. Introduce this lesson by reviewing on the chalkboard or an overhead projector the names and characteristics of each of the four models presented in the previous cluster.

2. Before school prepare a cup with coffee stirrer and drink powder in it as on page 178. Label with time you prepared it. Prepare another cup every 30 minutes. This will provide an example of a time line of the mixing.

3. Draw students attention to prepared cup(s). Then demonstrate how to prepare a cup.

4. Paraphrase column one, page 178. Then have students read it.

5. Have each student prepare a cup and write down observations. Ten minutes later have them observe cup again and write down observations.

6. Make 4 columns on chalkboard. Label each with name of one of the models. Add columns for models students have invented. Write names of students under models as they vote for which one they think explains what happens. Then work with students on questions 1-5.

DESIRED LEARNING OUTCOME: The students should be able to judge how useful the mixing models are at explaining a new mixing interaction.

* * *

INTRODUCTION: Lesson Cluster 3A-3 Models of Mixing and Unmixing
Page T-313/S-179 Slow Motion Mixing (30-40 min.)

PURPOSE: To predict results and explain new observations using several of the models presented previously and to determine the relative usefulness of these models.

ADVANCE PREPARATION: Materials -cups
-food coloring, dark
-unflavored gelatin
-grease pencils
-plastic wrap
-medicine droppers

TEACHING SUGGESTIONS:

1. Introduce this activity by reviewing on the chalkboard the names and characteristics of each of the four models presented in the previous cluster.

2. Paraphrase page 179, down to questions.

3. Demonstrate adding food coloring to gelatin as described on page 179.

Language Cards/Key Signs
sticky model
push model
small particle model
shake model
model
system
interaction
gelatin
food coloring
observation
plastic wrap
surface
evidence
predict

Identification Cards
food coloring
eye dropper
plastic wrap
cup
gelatin

4. Have students read page 179.

5. Distribute cups and have students prepare them as on page 179.

6. After students have observed gelatin for 5 days, and recorded their observations, work with them on questions on page 179.

DESIRED LEARNING OUTCOME: The students should be able to judge how useful the mixing models are at explaining a new mixing interaction.

****

DEVELOPMENT: Lesson Cluster 3A-3 Models of Mixing and Unmixing
Page T-314/S-180 Unmixing Mixtures (60 min.)

PURPOSE: To use a mixing model to explain the separation of colors by paper chromatography.

ADVANCE PREPARATION:

Background Information: Colored ink or food coloring consists of mixtures of several different colors. In this activity, unlike any so far, materials are going to be separated rather than mixed. The coloring will spread itself throughout the filter paper in distinguishable bands. The process is called chromatography. The students' task is to explain the separation of materials in terms of a model. Although there is no correct answer, the shake model is clearly the least effective in explaining separation. There is no observable shaking going on. However, the water does move up the filter paper, so the small particle model could explain the event. The sticky model could also explain why the coloring separates, since the water moves up the cone and could "come unstuck" from the coloring. It is also possible to infer that the colors push apart from each other, although the reasons for this action are not clear.

Have students remove the cones after about 25 minutes and allow them to dry. If the cones are left in the water too long, all the coloring will mix again.

Language Cards/Key Signs
- push model
- shake model
- sticky model
- small particle model
- mixture
- unmix
- liquid
- material
- common
- paper towel
- cone
- food coloring
- ink
- observation

Materials -cups
-water
-food coloring
-medicine droppers
-scissors
-tape
-filter paper or
heavy paper towels

TEACHING SUGGESTIONS:

1. Introduce the activity by reviewing the four models used previously. Then point out that this activity is the opposite of the others. In previous activities the students have been mixing; now they will separate what has previously been mixed.

2. Paraphrase page 180. Then have students read page 180.

3. Demonstrate activity on page 180.

4. Paraphrase paragraphs 1 and 2, page 181.

5. Divide students into groups of two. Have each group do the activity.

6. Paraphrase paragraph 3, page 181. Demonstrate with cone you prepared earlier. Then have students follow through at appropriate time.

7. Work with students on questions in column one, page 181.

8. List models on board. Ask students which one(s) apply to this activity.

DESIRED LEARNING OUTCOME: The students should be able to evaluate how useful the mixing models are in explaining color separation by paper chromatography.

****

APPLICATION: Lesson Cluster 3A-3 Methods of Mixing and Unmixing
Page T-317/S-182 Mixing Paint (30-45 min.)

PURPOSE: To evaluate how useful a model is in explaining why paint colors mix.

ADVANCE PREPARATION: Materials -1 tube each of blue and white artist's paint
-artist's paint brush

Language Cards/Key Signs
shake model
push model
sticky model
small particle model
What model is best here?
pallette
interaction
tube
mixing
paint
interation
concrete
artist

Identification Cards
paint

TEACHING SUGGESTIONS:

1. Introduce this activity by reviewing on the chalkboard the names and characteristics of each of the four mixing models.

2. Paraphrase column one, page 182. Then have students read it.

3. Have students read column two, page 182.

4. Take out 2 tubes of paint and replicate activity describes on page 182. Encourage students to examine your work.

5. Using Language Card, "What model is best here?" work with students on questions, page 182. The push model will probably be chosen by many students to explain this mixing interaction. The paints are "pushed" around by the brush until the colors are mixed. The sticky model and the small particle model can also be used to explain the mixing. Some inventive students may decide that two or more models can be combined to explain the interaction. For example, the paints might be made up of small particles that are interspersed and unstick from each other by being pushed around by the brush.

DESIRED LEARNING OUTCOME: The students should be able to evaluate how well a model explains the mixing of paints.

****

EVALUATION: Lesson Cluster 3A-3 Methods of Mixing and Unmixing
Page T-318/S-182 The Amazing Cotton Ball (50-60 min.)

PURPOSE: To evaluate the students' preformance in relation to the following objectives:

1. Recording their observations on mixing interactions.
2. Explaining their observations in terms of one or more models.
3. Ranking models according to their degree of success in explaining observations.
4. Designing and carrying out an experiment to determine the cause of an observed effect.

ADVANCE PREPARATION: Materials -plastic cups
-water
-cotton balls
-rubbing alcohol
-paper and pencils

Language Cards/Key Signs
What happens?
What interacts with the water?
mixing
interaction
cotton ball
alcohol
evidence
observe
effect
fair
experiment
model

Identification Cards
alcohol
cotton ball
cup

TEACHING SUGGESTIONS:

1. Introduce the activity by explaining that in this activity the students will not only try to explain what they observe in terms of a model chosen, but they will also make up an experiment of their own.

2. Paraphrase column one, page 183. Demonstrate procedure. Caution students to keep alcohol away from their eyes and face. Stress that they should observe the water under the cotton immediately after dropping in the ball.

3. While they are carrying out the activity, move around the room and encourage them to invent their own experiment to discover the cause of the wave effect. If they are obviously having difficulty, you might suggest an experiment to them.

4. After students have completed the activity, discuss it thoroughly, challenging them to explain the interaction using each of the models previously introduced. Have the students rank the usefulness of the model.

5. If a student correctly responds to most of the questions, you may assume that he of she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Part B The Small Particle Model, Lesson Cluster 3B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Number & Title	Teaching Time Suggested
T-324	Introduction	How Did the Solid Get Out?	50-60 min.
T-326	Development	Becoming a Mixing Model	60-70 min.
T-328	Development	Space in Matter	60-70 min.
T-329	Application	Which Will Mix Faster?	35-45 min.
T-330	Application	Temperature and Dissolving	50-60 min.
T-331	Evaluation	Which Is in Hot Water?	30 min.

B. MATERIALS: Add the following to the list on page T-321:
-4 or 5 balls of hard candy

FILMSTRIP INFORMATION: Filmstrip Set XVIII, Indivisible Systems, is appropriate for use in this unit.

INTRODUCTION: 3B-1 What Is the Small Particle Model?
Page T-324/S-185 How Did the Solid Get Out? (50-60 min.)

PURPOSE: To explain how a solid passes through a tea bag in terms of the small particle model.

ADVANCE PREPARATION:

Background Information - The small particle model is introduced in 12 parts in Part B of this unit. The 12 parts are (1) all matter is made up of particles, (2) particles of matter are very small, (3) particles of matter have spaces between them, (4) particles of matter are in constant motion, (5) particles of matter move faster when the matter is heated, (6) particles of matter usually move farther apart when the matter is heated, (7) in the gas phase, the particles of matter are far apart and move freely, (8) in the solid phase, the particles of matter are packed together in a pattern and move within a small space, (9) in the liquid phase, the particles of matter are loosely clustered together and move about more than in solids, (10) matter can be changed from solid to liquid and from liquid to solid, (11) matter can be changed from liquid to gas and from gas to liquid, and (12) particles of matter attract each other. Parts 1, 2, and 3 are introduced in this lesson.

Sugar placed in a dry tea bag will not pass through the bag. However, if the bag is placed in water the sugar will pass through. Of all the models presented earlier, the small particle model most reasonably explains this phenomenon. The water interacts with the sugar causing it to separate into small enough particles to allow them to pass through the small holes of the tea bag.

Materials - magnifiers
- lined paper and pencils
- scissors
- empty tea bags
- teaspoons
- clean plastic cups
- sugar
- transparent tape

Language Cards/Key Signs
watch closely
small particle model
Which are bigger?
What do you observe?
interaction
magnifier
matter
particle

Identification Cards
teabag
cup
sugar

TEACHING SUGGESTIONS:

1. Review previous activities in which students developed models for unseen interactions and evaluated models of mixing and unmixing. Remind students of their experiences with dissolving solids.

2. Demonstrate the procedure. Cut the top or side off a bag so the bottom is a folded edge, not a glued edge. Empty the tea out of the bag.

3. Place half a spoonful of sugar in the bag and tape the bag over the end of the cup. As you add the water (just enough to touch the bottom of the bag), using language cards tell the students to watch closely what occurs at the point where the water meets the bag.

4. Paraphrase p. 185, then have students read it. Use magnifier to let them look at grains of sugar.

5. Distribute the materials and let students work in pairs.

6. Ask students to draw what happens in answer to question 1.

7. Discuss question 2. Draw a grid on chalk board to represent what a teabag looks like when magnified. Then, have student's look at an unused teabag through a magnifier. Finally, using the grid on the chalkboard, draw dots representing particles in some holes in the grid. Describe answer to question 2. During the discussion be sure they realize that even though the solid sugar grains were too large to pass through a dry bag, as the bag became wet the smaller particles of sugar in the sugar-water mixture passed through the bag.

DESIRED LEARNING OUTCOMES: The student should be able to explain how a solid is able to pass through a tea bag in terms of the small particle model.

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DEVELOPMENT: 3B-1: What is the Small Particle Model?
Page T-326/S-186 Becoming a Mixing Model (60-70 min.)

PURPOSE: To introduce a model of mixing and to evaluate the model in terms of the small particle model.

ADVANCE PREPARATION:
On the chalkboard prepare a chart similar to the one below

		Team W Number of paper wads		Team Y Number of paper wads	
		At start	At finish	At start	At finish
Try # 1	W wads				
	Y wads				
	TOTAL				
Try # 2	W Wads				
	Y wads				
	TOTAL				
Try # 3	W wads				
	Y wads				
	Total				

Materials - transparent tape
- unlined yellow paper (8½ in. x 11 in.)

Language Cards/Key Signs
mixing model
small particle model
interaction
model

Identification Cards
paper wad

TEACHING SUGGESTIONS:

1. Review with the students their past experiences with mixing. Then tell them they will have an opportunity to simulate what happens when two substances mix.

2. Paraphrase p. 186-187. Demonstrate crumpling paper to make a paper wad and throwing a paper wad. Then have students read p. 186-187.

3. Distribute the materials and divide the students into two teams. Have each team member crumple three sheets into paper wads. Caution students not to make them too small as they could be dangerous.

4. Signal "Start." Then a minute later signal "Stop." Remind the students that they are to throw back any paper wads they can reach on their side of the line.

5. After "stop" has been called count the number and color of wads on each side of the line and record the results on the chalkboard in the chart.

6. Redistribute the wads as they were originally and repeat the exercise two more times. If mixing is not occuring equally, encourage more enthusiasm in mixing or increase the mixing time.

7. Discuss with the students the questions on page 187 at the completion of the activity. Emphasize that simulated models have many weaknesses, such as: particles of matter are constantly moving without being tossed; particles of matter are extremely small; and, particles of matter maintain their movement and do not stop and wait to be tossed again. (List these 3 characteristics on board or overhead overlay.) However, the activity does help the students evaluate their mental models and modify these models in relation to the evidence.

DESIRED LEARNING OUTCOMES: The students should be able to produce a model of mixing and evaluate it in terms of the small particle model.

****

DEVELOPMENT: 3B-1 What is the Small Particle Model?
Page T-328/S-188 Space in Matter (60-70 min.)

PURPOSE: To demonstrate the reduction in volume of a liquid mixture and explain it in terms of the small particle model.

ADVANCED PREPARATION:

For this activity you will need medicine droppers, preferably with a glass stem that tapers toward the end. Unless the medicine dropper fits loosely into the straw, the students may have difficulty getting the water into the straw. When demonstrating the procedure for the class, slant the straw about 45 degrees.

Make a supply of food coloring to last throughout the cluster by mixing three parts food coloring concentrate to ten parts water.

Materials - 4 or 5 balls
- paper and pencils
- tape
- clear plastic straws
- rubber bands
- pencils, short stubs
- medicine droppers
- ethanol alcohol
- metric rulers

TEACHING SUGGESTIONS:

1. Explain to the students that they will now do an activity and see if they can interfer more elements or parts to the small particle model.

Language Cards/Key Signs
small particle model
medicine dropper
particle
alcohol
air bubble
investigation

Identification Cards
medicine dropper
straw
food coloring
alcohol
pencils

2. Show them a pencil, tape, plastic straw, water to which food coloring has been added, and alcohol.

3. Paraphrase p. 188 column 1 and paragraphs 1 to 4 in column 2.

4. Demonstrate how they are to tilt the straw about 45 degrees to the horizontal and add the water layer and alcohol to the straw. Show how to mark the height of the liquid in the straw, mix the liquids, and look for a change in the height of the liquid column.

5. Show the students how they should measure the change in height of the column of liquids. Then have them do the first part of the activity (column 1 and paragraphs 1 to 4 of column 2) as you move around the room to help those students who are having difficulty getting the water or alcohol into the straw.

6. Paraphrase paragraphs 5, column 2. Then help students do activity.

7. After the students have completed the activity discuss it thoroughly. You might do this by reminding the students that the water is made of small particles and the alcohol is made of small particles. If the total amount of liquid is less after mixing the alcohol and water, what inferences can you make in terms of the small particle model? From this activity most students will infer that the particles of matter must have moved closer together in order to have less volume. For this to happen matter must have spaces between the particles. Demonstrate by speading out some balls - this is what the colored water and plain water mixture is like. Then push the balls closer together - this is what the alcohol and water mixture is like.

DESIRED LEARNING OUTCOMES: The students should be able to explain the change in volume of a liquid mixture in terms of the small particle model.

****

APPLICATION: 3B-1 What is the Small Particle Model?
Page T-329/S-189 Which Will Mix Faster? (35-45 min.)

PURPOSE: To determine the effect of temperature on the rate of mixing and to explain the rate of mixing in hot and cold liquids in terms of the small particle model.

ADVANCE PREPARATION:

Background Information - The purpose of this lesson is to give the students an opportunity to investigate the interaction of liquids at different temperatures. By knowing that particles of matter are in constant motion and that particles of matter move faster when the matter is heated, the students should be able to explain why hot liquids mix more rapidly than cold ones.

Materials - paper and pencils
- clear plastic cups
- medicine droppers
- 16 oz water and blue food coloring
- empty wide mouth containers

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TEACHING SUGGESTIONS:

Language Cards/Key Signs
small particle model
Which mixes faster
predict
medicine dropper
particle
observation

Identification Cards
medicine dropper
food coloring
cup
cold water
warm water

1. Introduce the lesson by reviewing what is known about the small particle model so far: all matter is made up of particles; particles of matter are very small; particles of matter are in constant motion; particles of matter have spaces between them. List characteristics as they are studied.

2. Paraphrase paragraphs 1 and 2, p. 189. Discuss. Then have students read p. 189.

3. Demonstrate the fair test.

4. Pass out materials to be used with the activity.

5. Have students do activity.

6. Give the students time to answer the questions and then discuss their predictions, results, and explanations in terms of the small particle model. Be certain they all realize that heat will cause the particles to move faster and therefore mix the food coloring faster. So another part of the small particle model is, that particles of matter move faster when the matter is heated.

DESIRED LEARNING OUTCOME: The student should be able to explain the rate of mixing in hot and cold liquids in terms of the small particle model.

* * *

APPLICATION: 3B-1 What is the Small Particle Model?
Page T-330/S-190 Temperature and Dissolving (50-60 min.)

PURPOSE: To determine the effect of temperature on the rate of mixing and to explain the rate of mixing (dissolving) of hot or cold liquids and solids in terms of the small particle model.

ADVANCE PREPARATION:

Background Information - This activity will give the students the opportunity to investigate the interaction of liquids and solids at different temperatures. By knowing that particles of matter are in constant motion and that particles of matter move faster when the matter is heated, the students should be able to explain why hot liquids dissolve solids more rapidly than cold ones.

Materials - paper and pencils
- clear plastic cups
- wide mouth containers
- ¼ cup of powdered fruit drink (dark color)

TEACHING SUGGESTIONS:

1. Paraphrase paragraphs 1 and 2, p. 190. Discuss.

Language Card/Key Signs
small particle model
What happens?
dissolve
observation
predict
fair test
evidence
particle

Identification Cards
cold water
warm water
fruit drink powder
cup

2. Paraphrase fair test. Then, have students read p. 190.

3. Demonstrate fair test.

4. Pass out materials and have students do activity.

5. Be certain students all realize that heat will cause the particles to move faster. Review with the students what is known about the small particle model so far: all matter is made up of particles; particles of matter are very small; particles of matter are in constant motion; particles of matter have spaces between them; and the part covered in this lesson, particles of matter move faster when the matter is heated. Add the new characteristic studied to the chart of small particle model characteristics which is on display in the room.

DESIRED LEARNING OUTCOME: The students should be able to explain the rate of mixing (dissolving) of hot or cold liquids and solids in terms of the small particle model.

****

EVALUATION: 3B-1 What Is the Small Particle Model?
Page T-331/S-190 Which Is In Hot Water? (30 min.)

PURPOSE: To evaluate student's performance in using the small particle model to explain common observations about mixing.

ADVANCED PREPARATION:

Materials - cups and hot water
- hard candy
- cool water
- paper, pencil & textbook

Language Cards/Key Signs
small particle model
particle
dissolve

Identification Cards
candy
cups

TEACHING SUGGESTIONS:

1. Before class prepare one cup hot water and one cup cool water. Place one piece hard candy in each. Label cup with hot water "A," with cool water, "B."

2. As class starts, fill 2 cups with water, one hot, one cool. Don't let student's know which is which. Set cups next to cups prepared before school. Hot cup should be next to earlier hot cup, cool next to cool. Then, in front of students, drop one piece of hard candy in each cup. Label cup with hot water "A", cup with cool water "B."

3. Paraphrase p. 191. Then have students read p. 191.

4. Have students write answers to questions.

5. During the discussion emphasize the five parts of the small particle model presented in this cluster: all matter is made up of particles; particles of matter are very small; particles of matter have spaces between them; particles of matter are in constant motion; particles of matter move faster when the matter is heated. Refer to chart of model's characteristics on display in room.

6. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 6 Unit 3 More Than One Model

Part B The Small Particle Model, Lesson Cluster 3B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-336	Introduction	Heating and Cooling a Liquid	50-60 min.
T-337	Development	Warming Air	45-55 min.
T-338	Application	Bridges and Tracks	35-45 min.
T-339	Evaluation	Expansion and Contraction	25-30 min.

B. MATERIALS: Add the following to materials list on page T-333:
- overhead overlay of thermometer on page 192 with strips of paper of different lengths to simulate liquid in thermometer
- overhead overlay of pictures A and B, p. 194
- 2 balloons
- 2 bottles

FILMSTRIP INFORMATION: Filmstrip Set XVIII, Invisible Systems, is appropriate for use in this unit.

INTRODUCTION: 3B-2 Heat Affects Matter
Page T-336/S-192 Heating and Cooling a Liquid (50-60 min.)

PURPOSE: To demonstrate and explain the expansion and contraction of a liquid in terms of the small particle model.

ADVANCE PREPARATION:

Background Information - Students used the small particle model to explain evidence of interaction through activities in Cluster B-1. You will probably find, however, that some students do not understand the small particle model as they attempt to explain certain other phenomena. For example, in the field testing of the activities in this cluster about half the students inferred that when a solid is heated the individual particles got larger instead of the particles moving faster when heated and the spaces between them becoming larger. Accept this alternative inference in the first several activities, but in the last activity in this cluster emphasize that scientists with additional evidence think that particles move faster when the matter is heated and that the spaces between the particles become greater.

In this lesson cluster, then, the following concepts will continue to be emphasized: 1) all matter is made up of particles, 2) particles of matter are very small, 3) particles of matter have spaces between them, 4) particles of matter are in constant motion, and 5) particles of matter move faster when the matter is heated. Part 6 will be developed – particles of matter usually move farther apart when the matter is heated.

The glass expands much less than liquid in a thermometer. Hence, volume of thermometer tube remains nearly unchanged while volume of liquid increases significantly when heated. This is why the column of liquid changes.

Language Cards/Key Signs
small particle model
What is the temperature?
What happens?

Identification Cards
warm water
cool water
thermometer

Materials - overhead overlay of thermometer, p. 192 with
- strips of paper of different lengths to simulate liquid in thermometer
- liquid at different heights in the thermometer
- clear plastic cups
- thermometers Celsius
- paper and pencils
- wide mouth containers
- hot and cold water

TEACHING SUGGESTIONS:

1. Demonstrate the proper way to hold, read, and care for a thermometer. Use overhead overlay to practice reading thermometer. Then give students a thermometer. Have them read temperatures on it.

2. Paraphrase column 1, page 192 and questions A, page 192. Have them read their thermometers again.

3. Demonstrate placing thermometer in warm, and in cool, water.

4. Have students read page 192.

5. Allow the students to work in pairs (one thermometer, one cup cold water, one cup warm water per pair). Have the students write answers to the question at the end of the lesson. During discussion of answers make certain that the small particle model parts stated in the Background Information above are emphasized. Use displayed chart of model characteristics.

DESIRED LEARNING OUTCOME: The students should be able to explain the expansion and contraction of a liquid in terms of the small particle model.

****

DEVELOPMENT: 3B-2 Heat Affects Matter
Page T-337/S-192 Warming Air (45-55 min.)

PURPOSE: To demonstrate and explain the expansion of a gas in terms of the small particle model.

ADVANCE PREPARATION:
The empty soda bottles should be the kind that have pry-off lids. Bottles with screw-tops tend to have necks too large to hold dimes on top. The bottles should be cold at the beginning of the activity. You can store them in a school refrigerator or in a styrofoam chest with some ice. If the weather is quite cold, the bottles can be left outdoors overnight for use the next day. Or, if the sun is out, place bottles with dimes in place in a sunny window.

Language Cards/Key Signs
small particle model
What happens as the air becomes warm?
matter
evidence
investigation
particle

Identification Cards
bottle
dime

Materials - paper and pencils
- empty soda bottles with pry-off lids
- dimes

TEACHING SUGGESTIONS:

1. Introduce this activity by reviewing the students' observations of the expansion and contraction of liquids and have them explain these observations in terms of the small particle model.

2. Now challenge the students to predict what will happen if a gas is heated. (The glass of the bottle also expands when warmed, but far less than the trapped air.)

3. Paraphrase, then have students read, page 193, paragraphs 1-4.

4. Then demonstrate the placement of a dime on a bottle and emphasize the need to have an airtight seal. This is why the dime should be wetted with water. (If the water seal isn't sufficient, try saliva.)

5. Have students work in pairs with one bottle and dime per pair.

6. After students have had time to perform and observe the activity, have them write out their answers to the questions at the end of the page.

7. Discuss the students answers to the questions, allowing any explanations for what happens as long as the explanations fit the evidence. Be aware that some students may interpret expansion in terms of the particles themselves expanding rather than the spaces between particles expanding.

8. Especially stress parts 5 and 6 of the small particle model in the discussion: particles of matter move faster when the matter is heated, and particles of matter usually move farther apart when the matter is heated. Refer to chart of model characteristics.

DESIRED LEARNING OUTCOME: The students should be able to explain the expansion of a gas in terms of the small particle model.

****

APPLICATION: 3B-2 Heat Affects Matter
Page T-338/S-194 Bridges and Tracks (35-45 min.)

PURPOSE: To explain the expansion and contraction of solids in terms of the small particle model.

Language Cards/Key Signs
small particle model
expansion
contraction
expansion joint

Identification Cards

ADVANCE PREPARATION: Materials - overhead overlay of pictures A and B, page 194
- paper and pencils

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing what happens when it is heated and cooled, and what happens to a gas that is warmed.

2. Ask the students to infer what might happen to a solid if it is heated or cooled. Have the students describe solids in terms of the six parts of the small particle model that have been developed so far. The six parts are 1) all matter is made up of particles, 2) particles of matter are very small, 3) particles of matter have spaces between them, 4) particles of matter are in constant motion, 5) particles of matter move faster when the matter is heated, and 6) particles of matter usually move farther apart when the matter is heated. Use chart of model characteristics.

3. Paraphrase, then have students read page 194.

4. Use overhead overlay of pictures A and B to work on question 1. If possible, visit a nearby bridge which has expansion joints.

5. Work on question 2 using model characteristics chart.

6. Work with students on question 3.

DESIRED LEARNING OUTCOME: The students should be able to explain the expansion and contraction of solids in terms of the small particle model.

****

EVALUATION: 3B-2 Heat Affects Matter
Page T-339/S-195 Expansion and Contraction (25-30 min.)

PURPOSE: To evaluate the students' performance in using the small particle model to explain expansion and contraction in gases and solids.

ADVANCE PREPARATION: Materials
- 2 balloons
- 2 bottles
- pan of hot water
- paper and pencils
- heat source
- ball and ring apparatus (optional)

Language Cards/Key Signs
small particle model
expansion
contraction

Identification Cards
balloon
bottle

TEACHING SUGGESTIONS:

1. Put balloons on 2 bottles before class. Put one bottle in a pan of hot water. Hide bottles.

2. Paraphrase, then have students read, column 1, page 195. Bring out bottles, label warmed bottle "B", the other one "A".

3. Have students look at, but not touch, bottles. Have them answer question 1.

4. Paraphrase column 2 then have students read it. Demonstrate ball and ring activity. The ball and ring apparatus will probably be available in your high school science department. If the ball will not fit through the ring at room temperature, cool it or heat the ring. Then, have them answer question 2.

5. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

Level 6 Unit 3 More Than One Model

Part B The Small Particle Model, Lesson Cluster 3B-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-344	Introduction	Properties of Gases	35-45 min.
T-346	Development	Melt Ice Race	50-60 min.
T-347	Development	Liquid to Gas to Liquid	50-60 min.
T-348	Application	Evaporation and Temperature	45-50 min.
T-349	Evaluation	How Does Popcorn Pop?	50-60 min.

B. MATERIALS: Add the following to the list on page T-341 -
picture of a clothes drier

FILMSTRIP INFORMATION: Filmstrip Set XVIII, Invisible Systems, is appropriate for use in this unit.

INTRODUCTION: 3B-3 Solids, Liquids, and Gases
Page T-344/S-196 Properties of Gases (35-45 min.)

PURPOSE: To demonstrate and explain the properties of gases in terms of the small particle model.

ADVANCE PREPARATION:

Background Information - Gases are composed of particles that have relatively large distances between them compared to solids and liquids. This is demonstrable by the fact that air is highly compressible. For example, a great deal of air can be forced into a bicycle tire by using a bicycle pump. As more pressure is added to the air in confined space the particles of air are forced closer together. Another property of a gas is that since there is so much space between the particles and since the particles move about so freely, the gas will fill any container in which it is put. Therefore, when a bag of air is collected the bag is full of air - there is no part of the bag that does not have air in it. A liquid will become a gas (evaporate) when the particles receive enough energy to cause them to move far enough apart to be in the gaseous phase. In a liquid evaporating into a closed space, more and more particles will move into the space until it is saturated with the gas or until all the liquid has evaporated. This lesson demonstrates these principles.

Materials - perfume
- paper and pencils
- sandwich bags, plastic
- twist ties
- bicycle pump
- bicycle tire (optional)

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing the parts of the small particle model previously presented, use chart of model characteristics. Then indicate that this model will be extended to explain the properties of solids, liquids, and gases, and how matter changes from one phase to another.

2. Paraphrase, then have students read column 1, page 196. Then distribute the plastic sandwich bags.

3. Encourage the students to list properties of air by asking such questions as: How do you know you have something in that bag? How much is in your bag? Is your bag full? Half full? Is there any part of the bag that has no air in it?

Language Cards/Key Signs
What happens?
Is your bag half full?
Is there any part of the bag that has no air in it?
small particle model
How do you know you have something in the bag?
How much is in your bag?
Is your bag full?
properties
evaporate
pollution

Identification Cards
tire pump
small plastic bag
perfume

4. Demonstrate the tire pump with several of the students as outlined on page 196. In addition you may wish to pump up a tire tube, or have the students take turns doing so. This takes some work but with hard pushing an increasing amount of air can be forced into the tube, causing the tube to become harder, demonstrating the compressibility of air.

5. Paraphrase then have the students read page 197 down to the numbered questions.

6. Before placing the perfume in the center of the room, arrange the students in circles around the perfume. Then do the demonstration.

7. Allow the students time to write answers to the three numbered questions. Then work with students on the questions.

DESIRED LEARNING OUTCOME: The students should be able to state the properties of a gas and explain these properties in terms of the small particle model.

****

DEVELOPMENT: 3B-3 Solids, Liquids, and Gases
Page T-346/S-198 Melt Ice Race (50-60 min.)

PURPOSE: To identify energy givers and energy receivers in the melting of ice and to explain melting in terms of the small particle model.

ADVANCE PREPARATION:
Background Information - Heat may cause a solid (in which the particles are packed together in a pattern and move within a small space) to change to a liquid. Heat increases the movement of the particles, which in turn increases the space between the particles and allows them to slide in and about each other - which is characteristic of a liquid.

Practically all matter will decrease in total volume as it freezes. Thus, most solids are more dense than the liquid phase. One exception to this general pattern is water. As water gets colder the particles get closer together until 4°C (the temperature at which water is most dense). From 4°C to 0°C the particles begin to spread out again as the water freezes. This expansion occurs because of the unique molecular structure of the water molecule and the way water molecules arrange themselves to form the solid. As ice is cooled below 0°C, it contracts like most solids.

Materials - paper and pencils
- sandwich bags and ties
- ice cubes
- vial or pill bottles with caps
- metric rulers

Language Cards/Key Signs
small particle model

Identification Cards

TEACHING SUGGESTIONS:

1. Paraphrase, then have the students read the first two paragraphs on page 198. Then go over the five rules listed in the first column after the purpose of the game has been established. Have rules written on chalkboard. Make certain all students have a clear understanding of the rules before you distribute materials. Caution the students not to rub or pound the ice cube and break the bag.

2. Distribute the materials. Then allow the students to start on your signal, and five minutes later stop on your signal.

3. Have the students measure the height of the water in their vials in millimeters.

4. Record their findings on the chalkboard.

5. Paraphrase, then have students read, paragraphs 1 and 2, column 2.

6. Work with students on questions 1-6. Draw models in #5 on chalkboard. Have the students write their answers to questions 1-6. Discuss the methods used by the most successful students. Then discuss the variables that affectthe amount of ice melted. Have the students identify the energy giver, which is usually their hands or their body, and the energy receiver, the plastic-bag-water-ice cube system.

DESIRED LEARNING OUTCOME: The students should be able to identify energy givers and energy receivers in the melting of ice, and explain melting of a solid in terms of the small particle model.

****

DEVELOPMENT: 3B-3 Solids, Liquids, and Gases
Page T-347/S-199 Liquid to Gas to Liquid (50-60 min.)

PURPOSE: To review the small particle model, and use it to explain the processes of evaporation and condensation.

ADVANCE PREPARATION:
Background Information: Condensation is the reverse of evaporation. The removal of heat energy from a gas will cause the gas particles to decrease their movement and the space between them. The particles will finally come so close together they form drops, and fall out (condense) as liquid.

Materials - paper and pencils
ice cubes
tea kettle, 1/5 full with water (optional)
heat source (optional)
fire extinguisher (optional)

Language Cards/Key Signs
small particle model
changes of phase
gas
solid
liquid
water vapor

Identification Cards

TEACHING SUGGESTIONS:

1. Paraphrase, then have the students read page 199 through question 1.

2. Do the pictured activity as a demonstration. (CAUTION. Make certain students are kept away from the heated material you'll be using.) Begin heating a tea kettle about one-fifth full about 15 minutes before the demonstration. Show students ice cubes in tray. Once the water is boiling, place the tray of ice cubes above the steam and allow students to observe what happens to the steam as it strikes the tray of cubes.

3. Explain that water vapor is invisible. The cloud of steam is made of droplets of water condensed by the relatively cool air in the room. Draw process (heat boils water, forming steam, - which condenses to liquid again). Ask "What is happening to ice cubes in tray?"

4. Work with students on question 2. Draw models on chalkboard.

5. Work with students on questions 3 to 5.

DESIRED LEARNING OUTCOME: The students should be able to explain the processes of evaporation and condensation in terms of the small particle model.

****

APPLICATION: 3B-3 Solids, Liquids, and Gases
Page T-348/S-200 Evaporation and Temperature (45-50 min.)

PURPOSE: To explain the relationship between an increase in temperature and an increase in the rate of evaporation.

ADVANCE PREPARATION: Materials - picture of clothes dryer
- paper and pencils

Language Cards/Key Signs
energy giver
energy receiver
small particle model
evaporation

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by placing a swath of water across the chalkboard with a sponge and asking such questions as: What will happen to the water? (it will evaporate) How long will it take? (a few minutes) What could speed up the evaporation? (add heat by means of a bright light or a hair dryer)

2. Display picture of clothes dryer. Paraphrase paragraphs 1, 2 on page 200.

3. Have students read page 200. Work with them on questions.

4. Discuss student answers, stressing those variables that tend to increase the rate of evaporation. Indicate that the same process is involved in the chalkboard example and in the book example - except that in the dryer additional heat is being added to increase the rate of evaporation. NOTE. In addition to heat, the movement of dry air over the wet clothes will also increase the movement of water particles into the air. This air is vented out of the dryer. In the winter some students may have noticed a cloud of water droplets coming from dryer vents.

DESIRED LEARNING OUTCOME: The students should be able to explain the evaporation of water in terms of energy transfer and the small particle model.

****

EVALUATION: 3B-3 Solids, Liquids, and Gases
Page T-349/S-201 How Does Popcorn Pop? (50-60 min.)

PURPOSE: To evaluate the students' performance in using the small particle model to explain phase changes of matter.

ADVANCE PREPARATION:

Background Information - Popcorn, a seed, contains a small amount of water. As the popcorn is heated quickly in a popper, the water changes to steam, expands with great force, and bursts the tough skin of the seed. As this eruption occurs, the cooked starch inside the seed expands and puffs up rapidly due to the steam. If the seeds are heated slowly in an oven , the water is driven off and fewer of the seeds will pop when placed in a popper.

Materials - paper, pencils and textbooks
- popcorn popper
- popcorn, oil
- measuring container

Popcorn preheated in the oven should be kept at 93°C (200 F) for 1 1/2 hours.

Language Cards/Key Signs

small particle model

Identification Cards
popcorn
popper
cooking oil

TEACHING SUGGESTIONS:

1. Have the students read page 201 to the numbered questions. Show them the popcorn that has been heated for an hour and a half and the popcorn that was not.

2. Pop each batch separately and have the students measure the volume of the popped corn and count the number of kernels not popped for each batch.

3. Have the students write answers to the numbered questions on page 201. Paraphrase questions as necessary. Discuss their answers with them, stressing attention on the parts of the small particle model that have been involved with this lesson. Refer to model characteristics chart.

4. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Part B The Small Particle Model, Lesson Cluster 3B-4

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-354	Introduction	Heaping Water	60-70 min.
T-356	Development	Water Surface and Paper Clips	60-70 min.
T-358	Enrichment	Did Your Finger Get Wet?	35-40 min.
T-360	Application	Measure the Grabbiness of Water	60-70 min.
T-362	Evaluation	Know the Surface	35-40 min.

B. MATERIALS: See list on page T-351.

Filmstrip Information: Filmstrip Set XVIII, Invisible Systems is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 3B-4 Surface Properties
Page T-354/S-202 Heaping Water (60-70 min.)

PURPOSE: To introduce and explain surface tension phenomena in terms of the small particle model.

ADVANCE PREPARATION:

Background Information - A particle in the center of a liquid is attracted equally in all directions by the surrounding particles. A particle on the surface of a liquid, however, is attracted downward and sideward but not in the upward direction. This unbalanced force tends to pull the particle toward the interior of the liquid and causes the surface to act as an elastic membrane. Soap reduces surface tension because the particles in soapy water do not attract each other as much as plain water particles do. Therefore soapy water will not heap as high as plain water.

Language Cards/Key Signs
- small particle model
- property
- diameter
- prediction
- particle

Identification Cards
- waxed paper
- medicine droppers
- soapy water
- plain water

Run off sufficient copies of Appendix J, Parts of the Small Particle Model for use as review with students. Prepare a liquid soap solution in a 3.8 L (1 gal.) container. Stir .18 L (3/4 cup) standard dish soap or detergent very carefully into 2.85 L (3 qts.) of water. Do not stir the water in such a way that soap bubbles are created. (Save the solution for use with lessons that follow.)

TEACHING SUGGESTIONS:

1. Provide each student with a copy of Parts of the Small Particoe Model. Go over each of parts 1-11 with the class. If there are questions on any parts,

refer back to the listed lesson cluster pages.

2. Now introduce part 12 by writing it on the chalkboard. Then begin the lesson with a general discussion of water drops. Ask questions such as: What is the shape of a raindrop? What is the shape of a drop of water? What is the shape of a drop of water on a windowpane? Write questions on chalkboard as you ask them.

3. Then tell the students that they are going to explore drops or piles of water on waxed paper and compare them with similar piles of soapy water.

4. Paraphrase, then have students read page 202. Draw chart on page 202 on chalkboard. Have students make a copy of chart.

5. Distribute the materials for measuring the piles of plain water. Caution students to make their piles in each of the corners of their wax paper so they don't run into each other.

6. Demonstrate the procedure that should be used in measuring water piles. Care should be taken not to get the rulers too close so the piles are disturbed.

7. Have the students complete the plain water part of their chart by following instructions on page 202.

8. The students can then complete the soapy water part of their chart. Review the results when they have finished by going over the questions at the top of the first column on page 203.

9. Have students make predictions on paragraphs 4, page 203, and question D. Write question on board.

10. Paraphrase the rest of page 203. Then have students read it. Provide each student with one vial of plain water and one of soapy water. Students should use one medicine dropper with the plain water and one with the soapy water. (If one dropper is used for both, make certain the dropper is well rinsed after being used with soapy water.)

11. Demonstrate activity, then have students follow instructions.

12. Work through questions with students. Refer to copies of Appendix J and wall chart of small particle model characteristics as necessary.

DESIRED LEARNING TOUCOME: The students should be able to explain the "heaping" of plain and soapy water in terms of the small particle model.

****

DEVELOPMENT: Lesson Cluster 3B-4 Surface Properties
Page T-356/S-204 Water Surface and Paper Clips (60-70 min.)

PURPOSE: To explain surface tension in a liquid in terms of the small particle model.

ADVANCE PREPARATION: Materials
-clear plastic sups
-medicine droppers
-paper towels
-liquid soap solution
-lined paper and pencils
-plastic forks
-magnifiers
-small paint brush (optional)

Identification Cards
paper clip
cup
magnifier
fork

TEACHING SUGGESTIONS:

1. Paraphrase paragraphs 1 and 2, page 204, then have students read them.

2. Demonstrate the activity procedure before passing out student materials. Emphasize that the paper clip has to be lowered very slowly into the water and the fork needs to be pushed beneath the water surface to allow the clip to rest on the surface. If the clip is not suspended successfully on the first try, both the clip and the fork should be carefully dried.

3. Demonstrate using a magnifier to examine the water surface.

4. Pass out materials except fork and paper clip to each student. Have them examine water surface. Work with them on questions.

5. Have students finish reading page 204.

6. Pass out fork and paper clip. Have students complete activity and answer last question.

DESIRED LEARNING OUTCOME: The students should be able to explain surface tension in a liquid in terms of the small particle model.

****

ENRICHMENT: Lesson Cluster 3B-4 Surface Properties
Page T-358 Did Your Fingers Get Wet? (35-40 min.)

PURPOSE: To demonstrate that the surface of a liquid acts as an elastic membrane. This lesson does not appear in the student text.

ADVANCE PREPARATION: Materials
-cups, 2/3 filled with water
-either talcum powder or bycopodium powder floating on surface

Language Cards/Key Signs
small particle model
talcum powder

Identification Cards
cups
talcum powder
water

TEACHING SUGGESTIONS:

1. Demonstrate what happens when you put your finger into a cup of water with powder floating on the top. Do not insert your finger more than 1.5 cm.

2. Distribute materials to students. Instruct them to insert a finger to about the bottom of the fingernail. If the finger is inserted carefully and not too deep, the surface tension of the liquid holding the powder will not be broken.

3. Have the students explain their observations in terms of the small particle model. Refer to display chart of small particle model.

DESIRED LEARNING OUTCOME: The students should be able to explain surface tension of a liquid in terms of the small particle model.

****

APPLICATION: Lesson Cluster 3B-4 Surface Properties
Page T-360/S-206 Measuring the Grabbiness of Water (60-70 min.)

PURPOSE: To measure the "grabbiness" of plain and soapy water and to explain the findings in terms of the small particle model.

ADVANCE PREPARATION:
Prepare duplicating master copies of Force Measurer, Appendix K for each of your students. IMPORTANT. The force measurers must be duplicated on ditto paper, not mimeograph or typing paper. Ditto paper is designed not to absorb water. Other papers get soaked and don't work. Four measurers are reproduced on each page so you'll need to separate them. Students can then cut out their own measurers and fold them as instructed.

Language Cards/Key Signs
surface tension
small particle model
grabbiness
force measurer

Identification Cards
plain water
soapy water
force measurer
cup
ruler

TEACHING SUGGESTIONS:

1. Paraphrase page 206, paragraphs 1 and 2.

2. Demonstrate the use of a force measurer. Show how to fold it in a spring-like fashion. Point out that the bottom of the measurer must be wet before beginning the fair test. Also stress that the measurement must be made from the edge of the tumbler to the top of the measurer.

3. Have students copy chart on page 206 and finish reading page 206.

4. Discuss question on page 206. Vote on which will hold paper more tightly. Write votes on chalkboard.

5. Working in pairs, have students make force measurers.

6. Demonstrate activity on page 207.

7. Paraphrase, then have students read page 207 down to questions.

8. Have students carry out experiment on page 207. They should take the four measurements with plain water before taking the four soapy water measurements. Suggest that the students do not change the force measurer between measurement of the plain water and the soapy water. Otherwise the test will not be a fair one.

9. After the students have completed the activity, discuss their findings. You

May wish to ask the question: Why did the force measurer stick to the water? (You may have to remind the students that they wet the bottom of the force measurer and that water is attracted to water.)

10. Now have the students answer the numbered questions on page 207. In the class discussion of their answers, be sure to use the phrase surface tension as another way of expressing the grabbiness of water. Refer to model display chart.

DESIRED LEARNING OUTCOME: The students should be able to explain the difference in the "grabbiness" of plain and soapy water in terms of the small particle model.

****

EVALUATION: Lesson Cluster 3B-4 Surface Properties
Page T-362/S-208 Know the Surface (35-40 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Describing forces acting upon particles in liquids.
2. Explaining water surface tension in terms of the small particle model.

TEACHING SUGGESTIONS:

Language Cards/Key Signs
surface tension
small particle model
water strider

1. Paraphrase, then have students read questions 1, page 208. Have them write down answers or draw answers.
2. Have students write answer to question 2.
3. Paraphrase, then have students answer question 3.
4. During the discussion have the students refer to their copies of Parts of the Small Particle Model that were used with the previous lesson. Go over those parts that particularly apply to this lesson, as well as doing a general review of all 12 parts. Also use display charts.
5. Collect the papers so you can evaluate each individual's progress. If a student correctly responds to the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 6 Unit 3 Models of Matter

Part C Models Must Be Tested, Lesson Cluster 3C-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-368	Introduction	Mixing Hot and Cold Liquids	35-45 min.
T-370	Development	Convection Currents	40-50 min.
T-371	Enrichment	Liquid Layers in Soda Straws	40-50 min.
T-372	Development	Evaporation and Condensation	40-50 min.
T-374	Application	The Water Cycle	50-60 min.
T-376	Application	Rain	30-40 min.
T-377	Evaluation	Motion of Matter	35-45 min.

B. MATERIALS: See list on page T-365.

FILMSTRIP INFORMATION: Filmstrip Set XVIII, Invisible Systems, is appropriate for use in this unit.

INTRODUCTION: 3C-1 Liquids and Gases Flow
Page T-368/S-210 Mixing Hot and Cold Liquids (35-45 min.)

PURPOSE: To investigate the effects of temperature and depth on the interaction of two liquids.

ADVANCE PREPARATION:

Background Information - As the students apply the small particle model to the various situations presented in this cluster, encourage them to think in terms of particle motion.

In the hot food coloring solution, the particles move faster and move farther apart. Compared to the cold water around it, the hot solution is lighter per unit volume because its particles are farther apart and there is more empty space between them. When a drop of hot food coloring is released under cold water, it will rise. When a drop of cold food coloring is released under hot water, it will sink because it is heavier per unit volume than the hot water around it.

Materials - For this activity you need a supply of hot food coloring and a supply of cold food coloring. You can prepare hot food coloring, and keep it hot, by floating a plastic cup with a small amount of food coloring in another plastic cup half full of hot water. You can prepare cold food coloring in a similar way by placing ice water in the bottom cup. You also need cold tap water or ice water for the vials. The colder the water, the more dramatic the reaction with the hot food coloring will be.

TEACHING SUGGESTIONS:

Language Cards/Key Signs
small particle model
prediction
particle

Identification Cards
medicine dropper
food coloring
vial

1. Introduce this lesson by reviewing the main features of the small particle model: particles of matter have spaces between them; particles move faster when the matter is heated; particles move farther apart when the matter is heated. Use display chart and Appendix J dittoes.

2. Paraphrase page 210, then have students read it.

3. Draw chart on page 210. Then have students copy chart.

4. Demonstrate the procedure for adding food coloring to a vial of water. Stress that students should release the drop of food coloring slowly, and not squirt it in. Tell them to watch carefully to see if the food coloring rises, sinks, or spreads out.

5. Paraphrase, then have students read page 211 to questions.

6. Let the students work in pairs. Distribute the materials. Have them proceed with the experiment, following the directions on page 211.

7. Circulate around the room to make sure students understand the directions and are recording their results.

8. Work through questions with students.

DESIRED LEARNING OUTCOME: The students should be able to explain the effects of temperature and depth on the mixing of two liquids in terms of the small particle model.

****

DEVELOPMENT: 3C-1 Liquids and Gases Flow
Page T-370/S-212 Convection Currents (40-50 min.)

PURPOSE: To detect the pattern of convection currents and to explain these movements in terms of the small particle model.

ADVANCE PREPARATION:

Background Information - This lesson can be done with the use of a demonstration. Compared to the cool water around it, the warm solution of food coloring is lighter per unit volume because its particles are farther apart and there is more empty space within it. Therefore, the warm solution will rise in the characteristic convection current pattern. When the solution cools as it mixes with the water, it will begin to spread throughout the container.

Materials - If you wish to do the demonstration in class, you will need two small jars labeled hot and cold. (Babyfood jars are ideal.) Put 30-40 drops of food coloring in one jar and fill it with very hot water. Put an equal amount of food coloring in the other jar and fill it with cold water. Cap the containers with aluminum foil secured by rubber bands. Fill two large, transparent containers with cold water.

TEACHING SUGGESTIONS:

1. Paraphrase paragraphs 1, 2, page 212. Discuss students ideas. Have them draw their ideas on chalkboard.

2. Paraphrase, then have students read the rest of page 212.

3. Show the students the small containers. Place each container at the bottom of the large transparent containers filled with cold tap water. Let the water stand a few minutes until the water becomes still. Put two holes in each aluminum foil cover with a pencil. If the hot food coloring does not mix after about one minute, increase the size of the pencil holes.

Language Cards/Key Signs
small particle model
convection current
heat energy
convection current
aluminum foil
particle

Identification Cards

4. Discuss the questions at the end of the activity, stressing the patterns the coloring makes in the cold water. Review the role of heat in the movement of particles.

DESIRED LEARNING OUTCOME: The students should be able to explain the pattern of convection currents in terms of the small particle model.

* * *

ENRICHMENT: 3C-1 Liquids and Gases Flow
Page T-371 Liquid Layers in Soda Straws (40-50 min.)

PURPOSE: To observe the mixing of liquid layers, infer the relative salt concentrations of three solutions, and explain the observations in terms of the small particle model. This lesson does not appear in the student text.

ADVANCE PREPARATION: Materials - For this activity you need to prepare three solutions, two of which contain salt. Take three liter quart jars and label them B (blue), C (clear), and G (green). The following chart shows the amount of salt to add to each.

Language Cards/Key Signs
medicine dropper

Identification Cards
food coloring
medicine dropper
straw
vial

Container	Color (added later)	Amount of Salt
B	blue	167 mL (2/3 cup)
C	clear	83 mL (1/3 cup)
G	green	none

Fill each jar with water and stir to dissolve the salt. Add the food coloring while you are introducing the lesson to the class.

TEACHING SUGGESTIONS:

1. Show the students the three solutions you prepared. Explain that one contains no salt. Of the remaining two, one contains twice as much salt as the other. Tell them the experiment will show which solution contains the most salt.

2. Explain that you will add some food coloring to identify each solution. Add 1 or 2 medicine droppers of coloring to the containers according to the chart above.

3. Use a soda straw and vials to show how to form the layers. Place the soda straw about 1 cm into a vial of the green solution. Put you index finger over the straw and withdraw the straw. Keeping your finger over the straw, place the straw in a vial of the blue solution, about 2 cm deep. Remove your finger briefly and then place it over the straw again. Show the students that you now have a blue layer on the bottom and a green layer on top. (You may want to have them practice this procedure with plain water before you distribute the solutions, since it requires considerable manual dexterity.)

4. Divide the class into groups of two. Give each group a vial of the three different solutions. Give each child a plastic straw.

5. Tell the students to try different arrangements of layers, to see in which order the layers mix most rapidly and in which the layers remain separate. (The arrangement in which the layers mix least should have blue on the bottom, clear in the middle, and green on top. The reverse arrangement should show the most rapid mixing.)

6. Circulate around the room to make sure the students understand the procedure and are recording their observations.

7. After the students have completed the activity, discuss it thoroughly. The students should understand that salt water has more particles per unit volume than ordinary water and is therefore heavier per unit volume than ordinary water. (Salt particles have filled some of the spaces between water particles.) The more salt you add, the heavier the solution becomes. Thus, least mixing occurs when the heaviest (most concentrated) solution is on the bottom and the lightest on the top. List the various possible combinations on the chalkboard and discuss each one.

DESIRED LEARNING OUTCOME: The students should be able to explain the interactions of three solutions in layers on the basis of the small particle model.

****

DEVELOPMENT: 3C-1 Liquids and Gases Flow
Page T-372/S-213 Evaporation and Condensation (40-50 min.)

PURPOSE: To provide evidence of evaporation and condensation and to explain them in terms of the small particle model.

ADVANCE PREPARATION:

Background Information - When heat is removed from a certain volume of humid air, the particles of water in the air come closer together. Eventually the particles will accumulate in large enough drops to fall out of the air or form on a cold surface. This process is condensation. On the contrary, if water is given enough heat, the faster-moving particles will break away from the other particles and move into the air as individual particles. This process is evaporation. (The slower-moving particles are left behind, so the remaining water is cooler.)

Materials - For this activity, you will need ice cubes. Condensation on a container of ice water forms slowly. You should therefore set up the containers with water and ice cubes 15 or 20 minutes before beginning the lesson. In this way, moisture will have begun to condense and the students will not have to wait to make observations.

Language Cards/Key Signs
evaporation
condensation
energy receiver
energy giver
small particle model
phases
matter

Identification Cards
ice cube
cup

TEACHING SUGGESTIONS:

1. Begin this activity by reviewing the phases of matter as explained by the small particle model. Tell the students that this activity will allow them to investigate changes from a gas to a liquid and from a liquid to a gas. Use display chart and student handouts about the small particle model.

2. Paraphrase paragraphs 1, 2 page 213.

3. Demonstrate adding ice to water. Then set out cups prepared earlier. Discuss questions A and B.

4. Paraphrase rest of page 213 to questions, then have students read it.

5. Distribute the materials and allow the students to do the activities. Tell them to rub the drop of water into the construction paper before fanning it, so that the drop does not roll off. If the water does not form on the cold tumbler (because of low humidity), have students breathe on the tumbler to obtain the desired affect.

6. Discuss the questions thoroughly. Stress that the source for the water on the cold tumbler is the air.

DESIRED LEARNING OUTCOME: The students should be able to explain the processes of evaporation and condensation in terms of the small particle model.

****

APPLICATION: 3C-1 Liquids and Gases Flow
Page T-374/S-214 The Water Cycle (50-60 min.)

PURPOSE: To apply the small particle model to the processes of evaporation, condensation, and the water cycle.

ADVANCE PREPARATION: Materials - Set up a simulation model for the water cycle, as illustrated on page 215 in the student text. Use a rectangular container or an aquarium sealed with plastic wrap. To have water droplets large enough for observation, the model should be set up 30-60 minutes before the lesson. (If you cannot do the set-up this far in advance, you can speed up the process by using hot water in the small container. This way, you can usually obtain good results in 15 or 20 minutes.)

TEACHING SUGGESTIONS:

1. Paraphrase, then have students read, page 214.
2. Review processes of evaporation and condensation.
3. Paraphrase, then have students read, column 1, page 215.

Language Cards/Key Signs

Where does rain come from?
evaporate
small particle model
water cycle
energy giver
energy receiver
What are the sources of water in the air?
What is the heat source for the evaporation of water?
simulation model
system

Identification Cards

container
aquarium

4. Show the students the model you set up. Call their attention to the water droplets forming at the top of the large container. Point out that the heat source is part of the model.
5. Discuss the questions on page 215.
6. Apply the principles of the simulation to the natural water cycle by asking the following questions: What are the sources of the water in the air? (evaporation from oceans, lakes, plants, and so on) What is the heat source for the evaporation of water? (sun) Where does rain come from? (Cool air causes water to condense and form clouds; still further condensation produces rain.)

DESIRED LEARNING OUTCOME: The students should be able to explain a simulation model of the water cycle in terms of the small particle model and apply the same principles to the natural water cycle.

* * *

APPLICATION: 3C-1 Liquids and Gases Flow
Page T-376/S-216 Rain (30-40 min.)

PURPOSE: To apply the concepts of evaporation, condensation, and the small particle model to the formation of rain.

TEACHING SUGGESTIONS:

1. Have the students read page 216 of the text. Sketch the simulation model of the water cycle on the chalkboard for review.

2. Discuss the cyclic process of evaporation from the oceans and lakes, condensation of water vapor in clouds, and rainfall that replenishes the oceans and lakes once more.

Language Cards/Key Signs
evaporation
condensation
small particle model
altitude

Identification Cards

3. Have the students answer the numbered questions at the end of page 216.

4. After the students have finished, discuss the questions. Students should be able to reason that rain will fall on the side of the mountains near the sea; the area on the other side of the mountains will probably be dry because the air has already dropped its moisture. Use drawings on chalkboard as necessary.

DESIRED LEARNING OUTCOME: The students should be able to explain rainfall in terms of evaporation, condensation, and the small particle model.

* * *

EVALUATION: 3C-1 Liquids and Gases Flow
Page T-377/S-217 Motion of Matter (35-45 min.)

PURPOSE: To evaluate the students' performance in applying the small particle model to convection currents, evaporation, condensation, and the water cycle.

TEACHING SUGGESTIONS:

1. Have the students read page 217 of the text and study the pictures very carefully. Paraphrase as necessary.

2. Tell them to answer the questions in writing. Allow students to make drawings as necessary.

3. Review the questions thoroughly with the class. Collect the papers so that you can evaluate individual progress. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objective for the cluster and is ready to go on to the next cluster.

Language Cards/Key Signs
water cycle
evaporation
condensation
small particle model
convection current

Identification Cards

* * *

Level 6 Unit 3 Models of Matter

Part C Models Must Be Tested, Lesson Cluster 3C-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-382	Introduction	Gases Mixing With Liquids	45-55 min.
T-388	Enrichment	Your Experiences With Soda Water	35-45 min.
T-384	Development	BTB and Carbon Dioxide	40-50 min.
T-385	Development	Limewater and Carbon Dioxide	40-50 min.
T-386	Application	What Can Get Out of a Plastic Bag?	50-60 min.
T-389	Evaluation	Gas Interactions	35-45 min.

B. MATERIALS: See list on page T-379.

FILMSTRIP INFORMATION: Filmstrip Set XVIII, Invisible Systems, is appropriate for use in this unit.

INTRODUCTION: 3C-2 Gases Interaction With Liquids
Page T-382/S-218 Gases Mixing With Liquids (45-55 min.)

PURPOSE: To investigate the interaction of carbon dioxide with water, and to explain the interaction in terms of the small particle model.

ADVANCE PREPARATION:

Background Information - Bromthymol blue (BTB) is an indicator that is blue in the presence of bases and yellow in the presence of acids. BTB turns yellow in this experiment because the interaction of carbon dioxide and water produces a mild acid, carbonic acid. The effect can be produced by carbon dioxide in exhaled breath, soda water, or seltzer tablets.

Materials - Prepare a BTB solution by adding about 35 drops of BTB to 3.5 liters of water. You may find it convenient to prepare more BTB solution to keep for later activities. Use approximately 10 drops of BTB per liter (quart of water. The solution can be stored in plastic milk containers.

If the BTB solution is yellow when you prepare it, add a very small amount of baking soda or household ammonia until the solution turns blue. Variations in the mineral content of the water can affect the color of the solution. Often the minerals will cause the BTB solution to turn green instead of yellow. But this color change will still indicate the presence of carbon dioxide.

TEACHING SUGGESTIONS:

Language Cards/Key Signs
small particle model
interaction
carbon dioxide
indicator
chemical
solution
colorless
soda water
seltzer

Identification Cards
BTB
soda water
seltzer tablet
cup
plastic straw

1. Paraphrase, then have students read, page 218.

2. Let the students work in groups of two. Distribute the materials for this experiment and have them do the activity. (Stress caution with the BTB solution.) The students should blow gently through the straws for at least 30 seconds.

3. Discuss their observations.

4. Put 2 cups in a place where they will not be disturbed. Note: The amount of carbon dioxide in the air is 0.03 percent, in exhaled breath 4 percent. Ordinarily no change will take place in the cups left overnight because there is not enough carbon dioxide in the air. However, a cup of yellow BTB solution (one that has had carbon dioxide added) may change back to blue when left to stand, as carbon dioxide escapes from the mixture and returns to the air.

5. Proceed to page 219. Paraphrase, then have students read paragraph 1. Then demonstrate activity.

6. Distribute the materials and have the students work in groups of two to perform the experiment.

7. Discuss what students observed.

8. Paraphrase, then have students read, rest of page 219. Have students do activity.

9. Discuss the questions at the end of the activity, stressing that carbon dioxide can be dissolved in water and that its presence can be detected with BTB solution.

10. You may want to explore with students ways in which the yellow BTB solution can be changed back to blue. You may want them to add a small amount of soda to observe this change.

DESIRED LEARNING OUTCOME: The students should be able to explain the interaction of carbon dioxide and water in terms of the small particle model.

****

ENRICHMENT: 3C-2 Gases Interact With Liquids
Page T-388 Your Experiences With Soda Water (35-45 min.)

PURPOSE: To demonstrate some factors that affect a gas-liquid mixture and to explain the observations in terms of the small particle model. This lesson, which does not appear in the student text, should follow (1) Gases Mixing With Liquids.

ADVANCE PREPARATION: Materials -

For this activity you need three identical bottles of soda water, two at room temperature and the other chilled. (Colorless soda water works better than cola, because the bubbles are more visible.) A watch or classroom clock with a second hand will be helpful in timing some of the interactions. If one is not available, students can count off the seconds. Open one bottle of warm soda and fill a vial. Carefully recap the bottle. Let the vial and the capped bottle stand undisturbed for an hour or so before the lesson.

Language Cards/Key Signs
small particle model
soda water

Identification Cards
soda water

TEACHING SUGGESTIONS:

1. Introduce the activity by asking the students, How do you prevent soda from going flat? (Keep it cold, capped, and unshaken) Which goes flat sooner, warm soda or cold soda? (warm) Will soda go flat faster with the cap on or the cap off? (cap off) If you shake it, will it go flat faster? (yes)

2. Place two identical bottles of soda - one cold, one warm - on newspaper. Ask the students to predict what will happen if the soda is shaken gently.

3. Half fill one vial with warm soda, another with cold. Place your thumb over each vial and shake each for 15 seconds. Have several students count the number of seconds each vial fizzes and compare the results.

4. Now show the class the vial of soda that has been standing open for an hour. Open the recapped bottle and half fill another vial. Again place your thumb over each vial and shake several times. Have students compare the number of seconds each fizzes. What was the effect of leaving soda uncapped?

5. Challenge the students to explain the escape of the gas in terms of the small particle model. Use small particle model wall chart and handouts (Appendix J). End the discussion by asking what can be done to prevent soda water from going flat and have them explain their ideas in terms of the small particle model.

DESIRED LEARNING OUTCOME: The students should be able to describe some factors that affect a gas-liquid mixture and explain the observations in terms of the small particle model.

* * *

DEVELOPMENT: 3C-2 Gases Interact With Liquids
Page T-384/S-220 BTB and Carbon Dioxide (40-50 min.)

PURPOSE: To investigate the rates at which a gas mixes with a warm liquid and with a cold liquid and to explain the difference in terms of the small particle model.

ADVANCE PREPARATION: Materials -

For this lesson you will need two containers of BTB solution, one hot and the other cold. You can heat or chill your existing supply; or you can prepare two liters of BTB solution, one liter using hot water and one liter using cold water. (See preparation instructions on page T-382.)

TEACHING SUGGESTIONS:

Language Cards/Key Signs
carbon dioxide
small particle model
BTB solution
interact
fair test

Identification Cards
straw

1. Introduce the activity by reviewing the gas-liquid mixture in the previous activity (see page 218) and read page 220 of the text.

2. Paraphrase, then have students read page 220, paragraph 1. Discuss question.

3. Paraphrase, then have students read, next paragraph.

4. Elicit some predictions of what the students think will occur.

5. Paraphrase, then have students read, down to questions 1, 2.

6. Demonstrate activity.

7. Let the students work in groups of two. Distribute the materials, cautioning the students to use care when handling BTB.

8. Discuss the questions at the end of the activity when the students have finished. Use display chart and handouts of small particle model. Be certain that the students realize that the increase in heat allows the carbon dioxide to move throughout the hot liquid faster, causing a faster change in color.

DESIRED LEARNING OUTCOME: The students should be able to demonstrate the rates at which a gas mixes with a warm and a cold liquid and explain the process in terms of the small particle model.

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DEVELOPMENT: 3C-2 Gases Interact With Liquids
Page T-385/S-221 Limewater and Carbon Dioxide (40-50 min.)

PURPOSE: To investigate the rates at which a gas mixes with a warm and a cold liquid and to explain the difference in terms of the small particle model.

ADVANCE PREPARATION: Materials - paper and pencils
limewater (optional)

Language Cards Key Signs
small particle model
indicator
carbon dioxide
limewater
interact
interaction

Identification Cards
limewater
straw
cup

TEACHING SUGGESTIONS:

1. Introduce the activity by reviewing the gas-liquid mixture in the previous lesson and indicate that another test for the presence of carbon dioxide in a solution of water is limewater. If limewater is available, you demonstrate the change. (Limewater is a calcium hydroxide solution. When carbon dioxide is added, the reaction forms a white solid, calcium carbonate. Tiny particles of this substance turn the water cloudy.)

2. Paraphrase, then have students read page 221 down to questions.

3. Demonstrate activity.

4. Discuss the questions at the end of the activity, being sure everyone realizes that the increase in heat causes the particles in both the gas and the liquid to move and mix faster, causing a faster change in the limewater.

DESIRED LEARNING OUTCOME: The students should be able to explain the difference in the rates at which a gas mixes with a warm liquid and with a cold liquid in terms of the small particle model.

****

APPLICATION: 3C-2 Gases Interact With Liquids
Page T-386/S-222 What Can Get Out of A Plastic Bag? (50-60 min.)

PURPOSE: To investigate the movement of particle through a plastic bag and to explain the movement in terms of the small particle model.

ADVANCE PREPARATION: Materials - BTB solution
plastic cups
seltzer tablets
plastic sandwich bags
paper and pencils
rubber bands

Language Cards/Key Signs
carbon dioxide
small particle model
airtight
watertight
BTB solution

Identification Cards
plastic bag
BTB solution
cups

TEACHING SUGGESTIONS:

1. Introduce the activity by asking if the students think any of the moving particles studied so far would go through a sealed plastic bag. You might ask them how they would construct a fair test to find out.

2. Paraphrase, then have students read column 1, page 22, and column 2 down to picture. Discuss question.

3. Students can work in groups of two. Demonstrate activity. Then have students label the bags to be used and fill them with air, water, or carbon dioxide. (To prepare carbon dioxide, use a seltzer tablet with water in a plastic bag, as shown on page 219. Only this time, have a second student hold the straw in a deflated bag by scooping it through the air, not by blowing into it.) Sealing the bag tightly is important. Instruct students to twist the end of the bag 5-10 times, double the twisted end over in a loop, and secure it with a rubber band or twist-tie.

4. Leave the bags to sit undisturbed overnight. Discuss the results and answer the italicized questions the next day.

5. Paraphrase, then have students read column 1, and column 2 down to numbered questions, page 223. Demonstrate activity. Discuss the experiment with the students before actually performing it to be sure everyone understand why containers C and D are necessary. (C is necessary to test whether the bag itself causes a color change; D is necessary to determine if the air in the room causes a color change.) Distribute the materials (a quarter-cup of BTB solution in each cup is sufficient) and have the students perform the experiment. Note: With some plastic bags, a transfer of carbon dioxide can be seen in a few minutes as the BTB at the bag's surface turns yellow. With other bags it may take longer.

6. Discuss the questions at the end of the activity after the BTB in the containers has changed color.

DESIRED LEARNING OUTCOME: The students should be able to explain the movement of gas particles through a plastic bag in terms of the small particle model.

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EVALUATION: 3C-2 Gases Interact With Liquids
Page T-389/S-224 Gas Interactions (35-45 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Explaining the mixing of a gas and a liquid in terms of the small particle model.
2. Identifying the gas carbon dioxide in exhaled breath.
3. Testing for the presence of carbon dioxide with BTB solution.

TEACHING SUGGESTIONS:

1. Paraphrase and have the students read page 224 and allow them time to write their answers.

2. Discuss the questions with the class. Collect the papers so that you can evaluate individual progress. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

Language Cards/Key Signs
small particle model
BTB solution
interact
infer
carbon dioxide

Identification Cards

****

Part C Models Must Be Tested, Lesson Cluster 3C-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-394	Introduction	Aristotle and Galileo	40-50 min.
T-396	Development	Testing Aristotle's Model of Falling Objects	45-60 min.
T-398	Application	Predicting Earthquakes	40-50 min.
T-401	Application	Life From Life	30-40 min.
T-402	Evaluation	Testing Models	30-40 min.

B. MATERIALS: Add the following to the list on page T-391 -
picture of a moth
cloth with holes cut into it or moth eaten garment

INTRODUCTION: 3C-3 Scientists and Models
Page T-394/S-225 Aristotle and Galileo (40-50 min.)

PURPOSE: To illustrate the need to test scientific models by experiment and to design a test for a specific model.

ADVANCE PREPARATION: Materials - paper and pencils

TEACHING SUGGESTIONS:

1. Introduce the activity by asking students to list some of the models they have studied in the last two units. (small particle model, earthquake model, dinosaur model, and so on) Tell them that there are many models in science and that in this cluster other models will be explored.

2. Ask students whether a heavy object will fall faster or slower than a light object, or whether both will fall at the same speed. Challenge the students to give reasons for their predictions.

3. Paraphrase, then have students read page 225.

4. Draw a tower on chalkboard. Add a man and 2 objects. Discuss.

5. Review the ways we evaluate the success of a model. (accuracy in describing an event and in predicting future events) Emphasize the importance of experimentation in this process.

Language Cards/Key Signs
thermometer

Identification Cards

6. Have the students write down their predictions and the methods by which they would test them. You may want to move on to the next lesson immediately, while the predictions are still fresh in the students' minds.

DESIRED LEARNING OUTCOME: The students should be able to make predictions about falling objects and suggest experiments to test the predictions.

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DEVELOPMENT: 3C-3 Scientists and Models
Page T-396/S-226 Teaching Aristotle's Model of Falling Objects
(45-60 min.)

PURPOSE: To test a model by experiment.

ADVANCE PREPARATION: Materials - paper and pencil
metal spheres, half of them of one weight and half of a greater weight
twine
index cards
paper punch

Language Cards/Key Signs
Aristotle's model
fair test

Identification Cards
metal sphere

TEACHING SUGGESTIONS:

1. Introduce the activity by reviewing the testing methods suggested by the students in the previous lesson. Review Aristotle's model for falling objects.

2. Paraphrase, then have students read, page 226, paragraphs 1, 2. Discuss questions.

3. Demonstrate the procedure, using students from the class to assist you. Emphasize the need to drop both spheres at precisely the same time.

4. Paraphrase, then have students read, rest of page 226, column 1 and paragraph 1, column 2 of page 227.

5. Draw chart on board. Divide students into groups of 3. Have each group draw a chart on the chalkboard.

6. Distribute the materials and allow the students time to practice dropping the spheres. Then have them perform the test. Have students fill in their chart.

7. Place a summary chart on the chalkboard at the end of the experiment. Indicate on the chart the number of times the large spheres hit first, the number of times the small spheres hit first, and the number of timesboth spheres hit at the same time. Note: The evidence may not be totally consistent. However, it will probably show that the spheres usually strike the floor at very nearly the same time. This evidence does not support Aristotle's model for falling objects.

8. Discuss the questions at the end of the lesson. Encourage the students to build a model that is consistent with their evidence. After several trials, most students will probably accept the model that objects all fall at the same speed, regardless of weight. Emphasize the importance to science of Galileo's position that all scientific models should be thoroughly tested by experiment.

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DESIRED LEARNING OUTCOME: The students should be able to test Aristite's model of falling objects.

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APPLICATION: 3C-3 Scientists and Models
Page T-398/S-228 Predicting Earthquakes (40-50 min.)

PURPOSE: To demonstrate that several models may be useful in predicting events, but that all models must be tested by experiment and observation to determine their success.

ADVANCE PREPARATION:

Background Information - In the course of this lesson, it should become clear to students that some models are easier to test than others. Aristotle's model could be tested directly. But many models are not so simple to test as Aristotle's. Some of the models that are most difficult to test concern events that cannot be duplicated exactly under laboratory conditions. Such events are often very large in scale, very far away, or in the distant past or future. (e.g. origin of the universe, the formation of mountains, or changes in world weather patterns.)

Some aspects of earthquakes can be duplicated in the laboratory with shaking tables and other equipment, but not all factors can be included. Even if scientists conclude that they understand what causes a quake, they can hardly test the theory by causing one. Students should come to understand some of these difficulties.

Materials - none.

Language Cards/Key Signs
earthquake
prediction
San Andreas fault
seismograph
computer

Identification Cards

TEACHING SUGGESTIONS:

1. Introduce the lesson by reviewing the test of Aristotle's model of falling objects. Emphasize that all scientific models must undergo similar tests.

2. Review what students learned about earthquakes in Unit 2. Discuss the difficulties in testing models about earthquakes. Be sure students understand that it is much easier to predict where an earthquake will occur than when.

3. Paraphrase, then have students read pages 228-230. Discuss each page after it is read. Discuss the models described in the text, plus any other available information on earthquake prediction from sources such as television specials and news reports. The emphasis should not be on the models themselves, but on the fact that many models are being tested. Note: Another way to predict an earthquake is by observing animal behavior. Animals sometimes exhibit behavioral abnormalities prior to a quake. These changes in behavior are apparently caused by changes in the earth's stability. Animal behavior was one factor in the prediction of the Haicheng quake, but studies in California have not shown consistent behavioral changes.

4. Allow the students time to answer the questions on page 230. The second question may lead to a discussion of situations in which science is involved with social responsibility.

DESIRED LEARNING OUTCOME: The students should be able to describe the importance of predicting earthquakes and discuss some of the difficulties in developing an adequate model to do so.

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APPLICATION: 3C-3 Scientists and Models
Page T-401/S-231 Life From Life

PURPOSE: To emphasize that all models should be tested by experiment and observation and to illustrate how a new model may replace an old one.

ADVANCE PREPARATION: Materials - picture of moth
cloth with holes cut in it
or moth eaten garment

Language Cards/Key Signs
Van Helmont
Redi
fair test
model
larvae

Identification Cards

TEACHING SUGGESTIONS:

1. Paraphrase, then have students read paragraphs 1, 2 on page 231. Show students picture of a moth. If possible, show them a garment with a moth hole, or a piece of cloth with some holes cut into it.

2. Paraphrase, then have students read, paragraph 3, page 231. Draw a fir tree, then draw it touching water with geese flying away. Discuss.

3. Paraphrase, then have students read, paragraph 4. Ask questions at top of column 2.

4. Paraphrase, then have students read rest of column 2. Discuss.

5. Write a brief description of each model on the chalkboard. The essential idea in van Helmont's model is that life can come from nonliving matter. Redi's model states that living things can only come from other living things of the same kind.

6. Discuss the importance of a fair test for each model, stressing that a model should be tested under a number of different circumstances. Had van Helmont left a shirt and wheat in a closed container through which only air could pass, there would have been no mice. (After seeing how carefully van Helmont conducted his plant experiment (page 6), one might suspect that his recipe for creating mice was offered up tongue-in-cheek.)

DESIRED LEARNING OUTCOME: The students should be able to explain how experimental evidence led to the replacement of one model by another.

****

EVALUATION: 3C-3 Scientists and Models
Page T-402/S-232 Testing Models (30-40 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Designing an appropriate experiment for testing a model.
2. Describing how a model could be tested by experimentation.
3. Describing the conditions that require a model to be changed or discarded.

TEACHING SUGGESTIONS:

1. Briefly review with the class the experiment with the falling spheres.
2. Drop a piece of paper. Have students observe its fall.
3. Paraphrase, then have students read, page 232. Allow them time to answer questions.
4. Discuss the answers, stressing the need to test each explanation and remain open to new evidence that may require changing the model.
5. Paraphrase, then have students read, page 233. Allow them time to answer questions.
6. Discuss answers.
7. Collect the papers so that you can evaluate individual progress. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster.

Language Cards/Key Signs
mosquito
malaria
falling objects
model
astronaut
Apollo 15
moon
earth
disease
microscope
organism

Identification Cards

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Level 6 Unit 4 Energy and Ecosystems

Part A Observing Ecosystems, Lesson Cluster 4A-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-414	Introduction	What Is an Ecosystem?	30-35 min.
T-416	Development	Making Model Ecosystems	60 min.
T-418	Enrichment	Decomposers	45-50 min.
T-419	Development	Ecosystems	30-35 min.
T-420	Application	Making a Closed Ecosystems	60 min.
T-422	Evaluation	A Nearby Ecosystems	45-50 min.

NOTE: Ecosystems In Space is an optional lesson due to the abstract and advanced nature of its concepts.

B. MATERIALS: See materials list on page T-411.

FILMSTRIP INFORMATION: Flimstrip XXI, Ecological Interactions is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4A-1 Ecosystems
Page T-414/S-236 What Is an Ecosystem? (30-35 min.)

PURPOSE: To introduce the concept of an ecosystem and provide practice in identifying examples of ecosystems.

ADVANCE PREPARATION:

Background Information: The concept of an ecosystem is one of the most important in biology. It tells us that organisms and their environment are completely interconnected in systematic ways. It tells us that to truly understand a population, an organism, or often even a single act of behavior by an organism, we have to study it in its context and see how it relates to the rest of the ecosystem. Of course, it can be more difficult to study whole systems than to study a single organism under laboratory conditions. But the rewards in terms of understanding how nature works are correspondingly greater, too.

Just what constitutes a particular ecosystem is not necessarily clear-cut. One ecosystem - a pond or a forest, for example - merges with another ecosystem - a shore or a field, for example - at its boundaries. To do a thorough study of the edge of a pond may require a scientist to regard the pond edge itself as a separate ecosystem with its own distinctive plants, animals, and physical conditions. Or, taking a larger view, it may make sense for the scientist to consider the pond and the forest as part of one larger ecosystem.

This does not mean the term "ecosystem" is loosely defined. Instead we are pointing out that nature is undivided, but we need to study it in pieces to make sense of it. When the parcel, or subsystem, of nature has been chosen for study, then we can investigate the systematic interactions that occur in it and try to understand how it works. Knowing how the parcels work, we can better understand the whole they make up.

Ecosystems are not static. The physical environment keeps changing because of sun, rain, wind, other physical factors, and because of the actions of the organisms that live there. And as the environment changes, the populations that adapt to it also change. Therefore, we study patterns of change, as well as the pattern at any given moment, when we study ecosystems.

Materials - None.

Language Cards/Key Signs
ecosystem
system
environment
mental models
interact

Identification Cards

TEACHING SUGGESTIONS:

1. Have the students read pages 236 and 237. Allow them adequate time to respond to questions 1-4. Teacher may paraphrase.

2. Discuss their answers and stress that in an ecosystem there must be at least several populations and some evidence that the organisms are interacting with one another.

3. Allow the students time to study the illustration accompanying question 5. This illustration emphasizes that ecosystems are mental models. One cannot study the whole environment at once. Dividing it up into ecosystems enables a scientist to work with a piece of nature of manageable size.

4. Ask the children to name ecosystems in the environment around the school. List on board. If weather permits, walk outside and identify these systems.

DESIRED LEARNING OUTCOME: The students should be able to define an ecosystem and identify examples of one.

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DEVELOPMENT: Lesson Cluster 4A-1 Ecosystems
Page T-416/S-238 Making Model Ecosystems (60 min.)

PURPOSE: To establish a model ecosystem and observe the interactions and changes that occur in it.

ADVANCE PREPARATION:
In this activity the students will set up terrariums with plant and insect populations, thereby creating model ecosystems. Clear gallon jars (have the cafeteria or a restaurant save some for you), plastic boxes, aquariums, large clear plastic bags, or even shoe boxes lined with plastic or aluminum foil make suitable containers. The containers should be covered to prevent the insects from escaping. Either punch small holes in the container tops or use pieces of screen.

The living and nonliving parts of the ecosystems can be collected or purchased. You may wish to have the students armed with plastic bags or jars, collect insect populations from their backyards or a nearby field or forest. You may wish to accompany them. They should also collect the necessary soil, pebbles, and plants. The best plants will be small ones found where the insects live. Alternatively, you can purchase these materials along with grass seed to start the plant population. Other habitat components such as twigs, stones, and pieces of bark should also be collected. These will provide cover for the insects.

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Students will make closed ecosystems later in the cluster. The organisms and other materials needed for that lesson should also be collected now. Have students collect several specimens of rotting leaves, wood, and so forth on this same collecting trip for use in lesson 3, Decomposers.

Acquiring these materials is a valuable learning experience for the students. Be sure to discuss page 238 with them before they go out collecting, so they know what kinds of things are needed.

TEACHING SUGGESTIONS:

1. Have the students read pages 238-239 and make a chart like the one on page 239. Teacher may paraphrase.

2. The ecosystems should be constructed in stages as described below. You may wish to have the class make three or more, depending on your room and resources. Instruct students to put 2-3 cm (1 in.) of gravel or pebbles in the bottom of the containers for proper drainage. Soil should be layered on top of the gravel. It should be 2-8 cm (1-3 in.) deep. They can add clumps of plants at this point or plant grass seeds, being careful not to overwater.

3. Instruct students to add other ecosystem components such as twigs and stones.

Language Cards/Key Signs
ecosystem
insect populations
organisms
ants
grasshoppers
beetles
soil
wood
microscope
microorganisms
factors
populations

Identification Cards
ecosystems - terrariums

4. Have the students add their insect populations now (ideally, two kinds per ecosystem). Instruct them not to put too many insects into each container. Six crickets, for example, are enough for a gallon jar.

5. Instruct students to add food such as apple cores or oatmeal. If students are using insect-eating insects such as praying mantises, they will have to add a prey population such as crickets.

6. As you move among the students to assist them, remind them to record on their charts the numbers of organisms they are adding. The school library should have books to help identify the plants and insects. They may or may not be able to count or estimate the number of plants in their ecosystems.

7. Have the completed models placed in an undisturbed area of the room, preferably not in direct sunlight. Be sure that the models are closed securely when they are being observed. Place Identification Card, ecosystems, near the display.

8. Have the students observe the models once a week at approximately the same time, to count the organisms and see how each ecosystem is faring. In addition, you might label each model and keep a running tally on the bulletin board of the numbers of individuals in each.

   Some of the insects will spend a lot of time under ground or under rocks, leaves, or other cover. It will not be possible to get accurate counts of their total populations. A possible strategy is to count the number visible at several times during the day and take an average. Put the average numbers in the chart and compare them over the four weeks to see whether the populations are increasing, decreasing, or staying the same.

9. At the end of four weeks have the students answer the questions on page 239 and discuss the results with them.

DESIRED LEARNING OUTCOME: The students should be able to build a model of an ecosystem and record population changes within this system.

* * *

ENRICHMENT: Lesson Cluster 4A-1 Ecosystems
Page T-418 Decomposers (45-50 min.)

PURPOSE: To investigate the actions of decomposers. This lesson does not appear in the student text.

ADVANCE PREPARATION:

Background Information - Fungi, mushrooms, molds, bacteria, and other tiny organisms break down wastes and dead matter from plants and animals. Without decomposers, ecosystems would soon fill up with dead organisms. By their actions, decomposers also perform the important action of recycling minerals necessary for plant life.

Materials - large plastic boxes or jars
- pebbles or gravel
- decomposing material such as rotting leaves and wood, wood with bracket fungi attached, or recently dead insects

Language Cards/Key Signs
decomposers
rotting leaves
rotting wood
mold
fungi

Identification Cards
ecosystems
decomposing terrariums

TEACHING SUGGESTIONS:

1. Ask students if they remember what decomposers are. Decomposers were studied on page 79. Review the role of decomposers with them.

2. Have the students bring into class, either in plastic bags or boxes, examples of materials undergoing decomposition. These can include rotting leaves, rotting wood, and recently dead insects. (You may wish to do the collecting yourself, or have students accompany you.) Remind students to handle these substances very carefully, as they may be crumbly. The substances should be kept intact if possible. Vacant lots, woods, parks, and backyards are all good places to look for specimens. Some specimens may have molds or fungi growing on them.

3. Have students prepare several "Decomposer Terrariums" for the class, following the general procedures described in Making Model Ecosystems. They should put gravel for drainage beneath the soil in the plastic bags or boxes. Then have them add the decomposing substances. No other organisms are necessary.

4. Have students observe and describe the state of the decomposing substances. Ask if they can tell what decomposers are at work. Are any of them visible? (Some molds and funguses may be.)

5. Ask why decomposers are important members of ecosystems. What would happen if there were no decomposers?

6. Have students set terrariums aside. Use the Identification Cards to label the display.

7. Have students carefully examine the decomposing substances at least once a week and describe any changes they observe. If the terrariums are kept damp, not wet, the decomposers should keep about their work and progressively break down the leaves, branches, and so on. This can be an interesting ongoing activity until the end of the school year.

DESIRED LEARNING OUTCOME: The students should be able to explain the role of decomposers and describe their effects on dea plants and animal matter.

* * *

DEVELOPMENT: Lesson Cluster 4A-1 Ecosystems
Page T-419/S-240 Ecosystems in Space (30-35 min.) Optional

PURPOSE: To develop the concept of an ecosystem as a partially self-sustaining unit, using a spaceship as a model.

ADVANCE PREPARATION:

Background Information - Ecosystems are partially self-sustaining units. They supply the materials and energy needs of their inhabitants and recycle their waste products. Ecosystems are not completely self-sustaining because they depend on various materials such as air and water that are cycled throughout the Earth. The microscopic plants in the ocean, for example, add oxygen to the wind that finally blows over inland ecosystems. But allowing for these exceptions, ecosystems are generally self-sustaining.

Spaceships can be considered to be at least partially self-sustaining ecosystems. If they do not rely on energy from the sun or another outside source, then for the length of their journeys, they must be completely self-sustaining. They must provide food and energy for the passengers and recycle wastes. Basically, they must be designed to function as food webs if very long journeys are contemplated.

Materials - None.

TEACHING SUGGESTIONS:

1. Instruct students to read page 240 and answer the numbered questions. Teacher may paraphrase.

2. Help the students organize the information as you discuss their answers in class by placing on the chalkboard a chart similar to this one.

Ways to Supply	Ways to Get Rid of Wastes From
Air Food Water Energy	Air Food Water Using Energy

Langauge Cards/Key Signs
outer space
spaceship
closed ecosystem
recycle
Earth
consumed
wastes

Identification Cards

3. Stress during the discussion that living organisms need not only food, air, water, and energy to live, but that the waste products of life's activitives must be recycled.

DESIRED LEARNING OUTCOME: The students should be able to state the environmental factors needed to maintain a healthy ecosystem.

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APPLICATION: Lesson Cluster 4A-1 Ecosystems
Page T-420/S-241 Making A Closed Ecosystem (60 min. or as 2 short lessons)

PURPOSE: To build a closed ecosystem and to observe how the requirements for life are sustained within the system.

ADVANCE PREPARATION: Materials - large jars of water, let stand for 24 hrs.
uncooked oatmeal
apple cores
pebbles or gravel
grass seed or clumps of grass and other plants
populations of ants, grasshoppers, crickets, beetles or isopods; 6-12 insects per population
sticks, stones, bark
paper and pencils
large jars (1 gal.)
rubber gloves
guppies
pond snails
green aquatic plants such as as elodea
washed sand

Language Cards/Key Signs
closed ecosystem
microorganisms
environment
organisms
aquatic systems
ants
crickets
beetles
isopods
guppies

Identification Cards
closed ecosystems

TEACHING SUGGESTIONS:

1. Have the students read the instructions for constructing their closed ecosystems on pages 241-242. Teacher may paraphrase. Also instruct the students to copy the chart found on page 242.

2. Review the procedure and chart carefully, reminding the students to keep accurate records of the types and numbers of organisms they place in their ecosystems.

3. Instruct the students to prepare half their closed ecosystems the same way they made model ecosystems in lesson (2). You may wish to have the class construct two or more, depending on your room and resources. When the jars are complete they must be tightly sealed with a rubber glove or a piece of heavy balloon over the end. A rubber band around the lip of the jar will help with the seal. These flexible seals will bulge inward or outward if the air volume inside changes.

4. Have students prepare closed aquatic ecosystems in two or more additional jars using water aged at least 24 hours. (The chlorine in fresh tap water will kill the fish.) Each aquarium should have a layer of clean sand at the bottom, some

guppies, and several snails and plants. The tops should be sealed with rubber gloves.

5. Suggest to students that the organisms may have a greater chance of surviving if there are not too many in each container. But do not tell students precisely how many to put in their ecosystems.

6. Allow them to put their closed ecosystems anywhere in the room. Use Identification Card as label for display. They may notice that the models become too hot in a sunny window or the plants do poorly in a shady spot. The models can then be moved to seek optimal light and heat conditions. Have the students observe their ecosystems carefully once a week at approximately the same time and record their observations on the charts.

7. Have the students answer the questions on page 242 at the end of the four-week period and discuss the results.

DESIRED LEARNING OUTCOME: The students should be able to describe how well their closed-ecosystem models provide the requirements for life.

****

EVALUATION: Lesson Cluster 4A-1 Ecosystems
Page T-422/S-243 A Nearby Ecosystem (45-50 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Identifying a local ecosystem.
2. Describing the environmental conditions in this ecosystem.
3. Listing several plant and animal populations in the ecosystem.
4. Stating several interactions that occur between organisms in this ecosystem.

TEACHING SUGGESTIONS:

1. Instruct the students to read page 243 and copy the chart.

2. Ask the students to fill out the chart either as an assignment at home or during and after a small walkiing field trip to an area near the school.

3. You may wish to paraphrase the chart headings as follows:
Location of ecosystem - Where is the ecosystem?
Conditions in the ecosystem - Describe the ecosystem.
Plant populations - What plants live there?
Animal population - What animals live there?
Food interactions you have noticed - How do the plants and animals get their food and what do they eat?

4. Discuss their results after the charts are completed. Stress these points: (1) At least two populations must be identified; (2) The physical environment of the ecosystem must be described; (3) Some interactions between the populations and the environment must be described.
If a student correctly fills in most of the spaces in the chart, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 6 Unit 4 Energy and Ecosystems

Part A Observing Ecosystems, Lesson Cluster 4A-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-428	Introduction	Everything Connects	30-40 min.
T-431	Development	Matter Cycles Through an Ecosystem	30-35 min.
T-432	Development	Where Do You Get All Your Energy?	20-30 min.
T-434	Development	Other Interactions	20-30 min.
T-436	Application	You Cannot Do Just One Thing	35-40 min.
T-437	Evaluation	Is a Zoo an Ecosystem?	20-30 min.

NOTE: Other Interactions is optional due to the abstract and unfamiliar nature of the concepts.

B. MATERIALS: Add the following to list on page T-425:
-picture of forest ecosystem as described on page T-428

FILMSTRIP INFORMATION: Filmstrip Set XXI, Ecological Interactions, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4A-2 Interactions in Ecosystems
Page T-428/S-244 Everything Connects (30-40 min.)

PURPOSE: To introduce the concept that various organisms in an ecosystem interact with one another and with the physical environment.

ADVANCE PREPARATION:

Background Information: Many interactions in an ecosystem involve transfers of energy and materials. These transfers can be described or listed in terms of givers and receivers, as students have done previously in the program. However, many important interactions cannot be usefully described in these terms - for example, the nesting of birds in a tree. When the class discusses the varied interactions of air, coil, tree, worms, and robins on page 244, you may find it helpful to make a chart on a chalkboard like the one shown here for you and the students to fill in.

Language Cards/Key Signs
- interactions
- connects
- forest ecosystem
- air
- soil
- worms
- tree
- birds
- robin
- energy transfer

ECOSYSTEM INTERACTIONS

Organism	Receives	From	Gives	To
elm	energy	sun	leaves (food)	worm

Other Interactions: Birds nest in tree.

Be sure that students do not get the impression from the chart that organisms are consciously giving things to one another because they know they are needed.

Materials: -picture of a forest ecosystem like on described in text, page S-244.

TEACHING SUGGESTIONS:

1. Have students read page 244. Teacher may paraphrase.

2. Discuss ways in which the ecosystem might be connected. Ask questions such as, What does the tree provide to the ecosystem? What does the worm get from the ecosystem? During this early part of the discussion, try to restrict examples to the organisms presented in the lesson. Use picture of forest ecosystem during discussion. Organize the information for the students on a chart such as the one given in Background Information.

3. Ask for examples of other organisms that might be added after the chart is completed. For example, squirrels eat the elm seeds and live in the elm tree. Their droppings fertilize the tree. Or you might add other birds, chipmunks, or insects.

4. Have the students study the illustrations on pages 245 add 246, and then discuss their responses to the questions. Depending on time and the extent of responses, you may wish to construct other charts that summarize the interactions discussed.

5. Ask the students at the end of the lesson to write down some ways in which the ecosystems they prepared in Cluster A-1 show interactions. Again, a chart such as the one illustrated may be helpful in organizing their information.

DESIRED LEARNING OUTCOME: The students should be able to list ways organisms in an ecosystem interact with one another and the physical environment.

****

DEVELOPMENT: Lesson Cluster 4A-2 Interactions in Ecosystems
Page T-431/S-247 Matter Cycles Through an Ecosystem (30-35 min.)

PURPOSE: To develop the idea that materials cycle through ecosystems.

ADVANCE PREPARATION:

Language Cards/Key Signs
cycles
transferred
snail
carbon dioxide
oxygen
minerals

Background Information: Materials that plants and animals need are transferred through ecosystems in cycles. A moment's reflection will show this must be true. Otherwise, crucial materials would get used up, and ecosystems would collapse. Special ecosystems such as farms will indeed collapse as successive crops deplete the soil of minerals, unless fertilizers are added.

There are two different cycles presented in this lesson. The first is a mineral cycle. Plants containing various minerals are eaten by worms, insects, other animals, and various microorganisms. Through their waste products and through the decomposition of their bodies, when they die these consumer and decomposer organisms put the minerals back into the soil for use by other plants.

The second cycle presented is the carbon dioxide exchange between plants and animals. The snail and the plants live together in the pill vial because the plants use the carbon dioxide waste generated by the snail and give off oxygen as waste during photosynthesis. Therefore, the snail does not die from an accumulation of its own waste. The snail is provided with the oxygen it needs, and the plant has a constant supply of carbon dioxide from the snail. (The plant also needs oxygen for respiration, but not as much as it puts out during photosynthesis.)

Materials: none

TEACHING SUGGESTIONS:

1. Have the students read page 247 and answer the questions. Teacher may paraphrase.

2. As an optional activity, have some students look up nitrogen fixation in the library and report back on nitrogen cycling between plants, air, and soil.

DESIRED LEARNING OUTCOME: The students should be able to describe material cycles in ecosystems involving plant nutrients and carbon dioxide oxygen transfers.

* * *

DEVELOPMENT: Lesson Cluster 4A-2 Interactions in Ecosystems
Page T-432/S-248 Where Do You Get All Your Energy? (20-30 min.)

PURPOSE: To develop the concept of energy transfer through an ecosystem.

ADVANCE PREPARATION:

Background Information: Materials cycle around in ecosystems, but energy passes through them. Energy transfers begin with plants, which can trap sunlight and convert it into energy-rich materials (glucose). Plant energy is used by plant-eating animals, which are in turn eaten by other animals. The last organisms in the energy-transfer chain are the decomposers. If students have studied Level 3 of this program, they have already been introduced to this topic.

Language Cards/Key Signs
solar energy
heat
sunlight
fuels
coal
oil
natural gas
firewood

Materials: none

TEACHING SUGGESTIONS:

1. Have the students read page 248 and study the illustrations carefully. Teacher may paraphrase.

2. Discuss with the students the forms of energy from the sun that are used in ecosystems on Earth.

3. Have the students then turn to page 249 and answer the questions there based on the illustration. Teacher may paraphrase.

4. Ask the students to consider ways energy is transformed in their model ecosystems and what the ultimate source of that energy is.

DESIRED LEARNING OUTCOME: The students should be able to describe the movement of energy through an ecosystem.

****

DEVELOPMENT: Lesson Cluster 4A-2 Interactions in Ecosystems
Page T-434/S-250 Other Interactions (20-30 min.) optional

PURPOSE: To explore the types of interaction in an ecosystem that are not directly related to transfers of food and energy.

ADVANCE PREPARATION: Materials - none

TEACHING SUGGESTIONS:

1. Have the students read pages 250 and 251 and study the illustrations carefully.

2. Ask the students for examples of similar interactions. They can probably think of other ways plant seeds are scattered by animals or of additional instances of organisms providing homes for other organisms. Two common examples are animals eating fruits whose seeds pass through them undigested and animals making nests in trees.

3. End the discussion of this lesson by asking students if they have observed similar examples of interactions in the model ecosystems.

Language Cards/Key Signs
- interactions
- pollen
- nectar
- reproduce
- fungus infections
- cleaners

DESIRED LEARNING OUTCOME: The students should be able to name several examples of interaction among living organisms within an ecosystem that are not directly related to food and energy transfers.

****

APPLICATION: Lesson Cluster 4A-2 Interactions in Ecosystems
Page T-436/S-252 You Cannot Do Just One Thing (30-40 min.)

PURPOSE: To illustrate how interconnected the parts of an ecosystem are.

ADVANCE PREPARATION:

Background Information: The deep interdependence of all the organisms in an ecosystem can be dramatically illustrated when a food web is altered. In this lesson an actual case history is described. The students should be able to predict the outcome.

Eliminating second-order consumers removes a natural population control on the first-order consumers. The numbers of the latter can be expected to increase until there is starvation and epidemic disease. By then, the producers have been seriously depleted, and there may be erosion problems and loss of top soil, which makes it that much harder for the plant population to reestablish itself.

Materials: none.

Language Cards/Key Signs
- Arizona
- producers
- first-order consumers
- deer
- mice
- rabbits
- chipmunks
- preyed on
- second-order consumers
- lions
- coyotes
- populations

TEACHING SUGGESTIONS:

1. Have the students read page 252 and answer the questions. Teacher may paraphrase.

2. Throughout the discussion that follows, emphasize the web - like nature of the interconnections in this example and in the previous lessons, as well as in the model ecosystems, the students prepared.

DESIRED LEARNING OUTCOME: The students should be able to predict the effects of significantly reducing a population of anumals in a food web.

****

EVALUATION: Lesson Cluster 4A-2 Interactions in Ecosystems
Page T-437/S-253 Is a Zoo an Ecosystem? (30-35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Giving examples of how materials cycle through ecosystems.
2. Giving examples of how energy is transferred through ecosystems.
3. Identifying beneficial interactions between organisms that do not involve eating.
4. Comparing the interactions in zoos and natural ecosystems.

PREREQUISITES: Understanding of what a zoo is.

TEACHING SUGGESTIONS:

1. Have the students read the problems on page 253. Allow them adequate time to write down their answers to the questions.

2. Review the answers with them in a class discussion. You may want to summarize the information on the board in a chart similar to the one suggested for the introduction. What are the organisms involved in each interaction? What do they receive as a result of the interaction? From whom? What do they give? To whom? What form of solar energy is used in the interaction?

   If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Part A Observing Ecosystems, Lesson Cluster 4A-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-442	Introduction	Organisms Change Ecosystems	20-30 min.
T-444	Development	Some Effects of Farming	20-30 min.
T-445	Development	Burning Down the Woods	20-30 min.
T-446	Development	The Effects of Livestock	45-50 min.
T-448	Development	Overfishing	20-30 min.
T-450	Application	Environmental Impact Studies	20-30 min.
T-452	Evaluation	Effects of People	30-35 min.

B. MATERIALS: See list on page T-439.

FILMSTRIP INFORMATION: Filmstrip Set XXI, Ecological Interactions is appropriate for use in this cluster.

INTRODUCTION: Lesson Cluster 4A-3 People Change the Face of the Earth
Page T-442/S-254 Organisms Change Ecosystems (20-30 min.)

PURPOSE: To assess the abilities of people to alter ecosystems.

ADVANCE PREPARATION:

Background Information: People are as much of the ecosystems they live in as other organisms are. Just like other organisms, we must satisfy our needs for survival. We need food, energy, shelter, and living space. In our attempts to satisfy these needs, we often significantly change the ecosystems we inhabit.

Change in itself is neither good nor bad. All organisms affect their ecosystems to some extent. Plants can colonize a mud flat and turn it into a moor or marsh. Beavers can turn a meadow into a pond. Many natural ecosystems are in a constant state of change, turning from one kind of place into another.

Some large-scale human alterations to the environment have clearly benefited people, providing us with farmland, food, materials, energy, open spaces, and other needs. Some changes have had unexpected negative effects. Side effects of the Aswan Dam are described on page 261.

Materials: none.

Language Cards/Key Signs
- organisms
- ecosystems
- beavers
- dams
- meadows
- ponds
- marshes
- ducks
- fish
- North America
- Egypt

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TEACHING SUGGESTIONS:

1. Have the students read pages 254-255 and answer the questions. Teacher may paraphrase.

2. Discuss the questions with them. To help summarize the information, you might take a comparative chart on the chalkboard, similar to the one shown here. You can tabulate the effects of dams and other construction projects on the environment and on the kinds of producers and consumers present before and after the project is built.

3. As an optional exercise for some, you might assign a report on the Aswan Dam and on beaver dams and have the students report their findings to the class.

PEOPLE CHANGE ECOSYSTEMS

Project	Purpose	Environmental Change		Producer Changes		Consumer Changes	
		From	To	From	To	From	To
1. Dam Building Building	water, energy, flood control	forest or valley	lake	trees, grasses, shrubs, wild-flowers	algae, water plants, etc.	deer, rabbits, etc.	frogs, fish, etc.

DESIRED LEARNING OUTCOME: The students should be able to name a few large construction projects and describe how they have changed the ecosystems where they took place.

* * *

DEVELOPMENT: Lesson Cluster 4A-3 People Change the Face of the Earth
Page T-444/S-256 Some Effects of Farming (20-30 min.)

PURPOSE: To assess how farmlands and natural ecosystems differ.

ADVANCE PREPARATION: Materials - none

TEACHING SUGGESTIONS:

1. Have the students read page 256 and answer the questions. Teacher may paraphrase.

2. Discuss the questions with the students and help them organize their information by making another chart on the chalkboard or by simply adding to the chart started during the previous lesson. Have them describe the nature of the ecosystem and list the populations of plants and animals before and after making farms. To fill in the "Before" column, ask students what are (or were) the native plants and animals in woodlands and meadows in their area. The students will probably need help with this information.

Language Cards/Key Signs
farming
prehistoric people
"face of the earth"
natural ecosystems
woods
grasslands
landscapes
fertilizers

3. When the chart has been filled in, ask which changes seem beneficial to people and which ones seem undesirable. There are no "right" answers to these questions. For example, the disappearance of native organisms may seem desirable to some

people, if the organisms were dangerous, or a tragic loss of wilderness to other people.

4. As an optional exercise you might have some students do a report on the Great Dust Bowl of the 1930's, in which poor farming and grazing practices had a disastrous effect on a huge ecosystem. Those students could report their findings to the class.

DESIRED LEARNING OUTCOME: The students should be able to state some effects of farming on the ecosystem.

****

DEVELOPMENT: Lesson Cluster 4A-3 People Change the Face of the Earth
Page T-445/S-257 Burning Down the Woods (20-30 min.)

PURPOSE: To develop the theme of large-scale changes to ecosystems by describing the first method people used to clear forests for hunting, farming, and grazing.

ADVANCE PREPARATION: Materials - none

TEACHING SUGGESTIONS:

1. Have the students read page 257 and study the illustrations. Teacher may paraphrase.

2. Discuss the answers to the questions. Students may be so used to warnings against starting fires that they are reluctant to see the desirability of doing so from the point of view of people not blessed with bulldozers.

3. Add this example of human changes to ecosystems to the chart begun earlier.

Language Cards/Key Signs
burn
forest fire
woods
primitive tribes
meadow
pasture
prairies
grasslands
landscapes
graze
bulldozers

DESIRED LEARNING OUTCOME: The students should be able to explain why clearing land by burning has provided important advantages to people.

****

DEVELOPMENT: Lesson Cluster 4A-3 People Change the Face of the Earth
Page T-446/S-258 The Effects of Livestock (45-50 min.)

PURPOSE: To illustrate the effect on ecosystems of overgrazing livestock.

ADVANCE PREPARATION:
Background Information: Overgrazing is the inevitable result of the unrestricted use of common grazing lands. The game the students will play simulates situations that have actually happened many times throughout the world. Some barren, eroded areas of the southwestern United States, for example, were once lush meadowland. The point to stress in this activity is not however, that people have destroyed large parts of the environment. Rather, stress that the environment has to be used carefully to prevent its being ruined.

Language Cards/Key Signs
livestock
hunt
raising herds of animals
fenced-in pastures
sheep
grass
overgrazing

Materials - scrap paper and watches or clocks with sweep second hand

TEACHING SUGGESTIONS:

1. Instruct the students to read pages 258 and 259. Teacher may paraphrase.
2. Review the game's procedure, emphasizing that the students add an "animal" every 30 seconds but do not add a "grass raiser."
3. Divide the class into groups of three. Playing the game should take less than 10 minutes. Let the students play it twice to make sure they get the point.
4. Discuss the questions in class. You may want to add this method of people's altering the ecosystem to the chart already begun. One obvious difference in this alteration is that the ecosystem can be almost entirely wiped out, since rain and wind can carry away the exposed topsoil essential for the growth of the producers, the plants.
5. Ask how overgrazing compares to the situation described on page 252. The imbalances of producers and consumers in both cases are similar.

DESIRED LEARNING OUTCOME: The students should be able to state the effect on an ecosystem of unrestricted grazing of livestock.

* * *

DEVELOPMENT: Lesson Cluster 4A-3 People Change the Face of the Earth
Page T-448/S-260 Overfishing (20-30 min.)

PURPOSE: To illustrate the effects of overfishing and to consider ways to control our use of natural food resources.

ADVANCE PREPARATION: Materials - none

Language Cards/Key Signs
New England
Canada
fishermen
bluefin tuna
Portuguese
sperm whales
sea turtles
overfishing
prey
endangered species

TEACHING SUGGESTIONS:

1. Have the students read the first two paragraphs on page 260 and stop to discuss the question at the end of the second paragraph. Teacher may paraphrase.
2. Add this alteration of ecosystems to the chart begun earlier, if you wish.
3. Have the students answer the three questions at the end of this lesson and discuss the questions thoroughly. Let the students express their feelings on this very current and important issue.
4. Suggest that interested students contact the National Marine Fisheries Service, Washington, D.C., to find out the current status of the bluefins.
5. Extend this lesson, if you wish, by having several students report on the status of blue whales, sperm whales, or some other endangered species they may have heard about. In these reports it is important to stress the reasons for the problem and what, if anything, people are doing or have already done to save the organism from extinction.

DESIRED LEARNING OUTCOME: The students should be able to describe the consequences to the ecosystem of overfishing a single kind of fish and the ways to prevent this from happening.

* * *

APPLICATION: Lesson Cluster 4A-3 People Change the Face of the Earth
Page T-450/S-261 Environmental Impact Studies (20-30 min.)

PURPOSE: To introduce a tool for preventing ecological damage: the Environmental Impact Study.

ADVANCE PREPARATION:

Language Cards/Key Signs
- environment impact study
- Aswan Dam
- Nile River
- mud
- snails
- farmlands
- minerals
- predict
- ocean
- hotel

Background Information: When the name-calling gets started between environmentalists and developers over a proposed construction project, it may seem as though the issue is nature versus people. Environmentalists are apt to be depicted by their opponents as loving plants and animals more than people. Developers are apt to be depicted as being insensitive to nature. The story of some of the Aswan Dam problems on page 261 shows the fallacy behind such simplifications. The real issues can never be nature versus people, because people are part of nature. We live in ecosystems, not outside them. Any serious disruption of a large ecosystem will affect people, too, sooner or later.

The Aswan Dam was built to supply electricity and regulate the flow of the Nile so it would not annually overflow its banks. The adverse effects of the dam are not limited to "nature." When marine food chains were severaly disrupted, fishing fleets returned to port with nearly empty holds. The loss of farmland and the epidemic spread of schistosomiasis due to the snails have deen disastrous for the local people. (Schistosomiasis is a severaly debilitating disease in which kidneys, liver, and lungs are attacked. The victims may eventually die.)

In case after case, when planners have left the environment out of their planning, people have eventually suffered, as well as other populations of organisms.

Environmental Impact Studies are used to try to prevent so-called "developments" from wrecking ecosystems. When the environment is taken into account by planners, the results can be true developments that benefit people, but not at the expense of the environment.

Materials - none

TEACHING SUGGESTIONS:

1. Have the students read pages 261-262 and allow them time to answer the questions. Teacher may paraphrase.

2. Encourage the students to review in their minds all the ways they have studied that people have adversely affected ecosystems. Ask if they see any chance of these problems being repeated in this situation. Where? How? How could it be prevented?

3. Write their reasons for or against each site on the chalkboard or set up a small debate on the issue if you wish. If necessary, play devil's advocate to help

students see all sides of the problem.

DESIRED LEARNING OUTCOME: The students should be able to assess the impact on the environment of a major construction project.

****

EVALUATION: Lesson Cluster 4A-3 People Change the Face of the Earth
Page T-452/S-263 Effects of People (30-35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Describing some changes in ecosystems that resulted from human activities.
2. Predicting how construction projects might affect natural ecosystems.
3. Proposing ways that people can use ecosystems without destroying them.

TEACHING SUGGESTIONS:

1. Have the students read the questions on page 263.

2. Review the questions with them and instruct them to answer the questions on a sheet of notebook paper.

3. Discuss the answers with them when they have finished. If a student correctly responds to the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 6 Unit 4 Energy and Ecosystems

Part B Resources and Problems, Lesson Cluster 4B-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-458	Introduction	We Cannot Make or Destroy Matter	20-30 min.
T-460	Development	Kinds of Resources	25-30 min.
T-461	Enrichment	Recycling Water	30-40 min.
T-462	Development	Why Conserve Resources?	20-25 min.
T-464	Development	How Can We Conserve?	20-30 min.
T-465	Application	Managing with Less	30-35 min.
T-466	Evaluation	Resources	20-30 min.

B. MATERIALS: Add the following to the list on page T-455:
-large poster size copy of chart "Natural Resources Used By People;" see lesson Kinds of Resources
-items made of recycled material

FILMSTRIP INFORMATION: Filmstrip Set XXI, Ecological Interactions, are appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4B-1 Conserving Resources
Page T-458/S-265 We Cannot Make or Destroy Matter (20-30 min.)

PURPOSE: To introduce the principle that matter can neither be created nor destroyed, and therefore there is a limit to our available resources and a limit to our ability to dispose of waste products.

ADVANCE PREPARATION:

Background Information: This cluster is about the reasons for conserving natural resources and methods of conservation. A conserving society will not run out of vital supplies. The other benefit of conservation is that we will not produce more wastes than our ecosystems can safely handle.

You might wish to emphasize to the students the tremendous varied demands we have placed on our ecosystem Do this by keeping an ongoing list of the natural resources we require, our uses for them, and ways to conserve these resources. It is neither possible nor even desirable to completely avoid producing waste products as we live. However, if the waste produced exceeds the ability of ecosystems to absorb it, then waste products accumulate, and we poison our own environment.

Language Cards/Key Signs
to make
create
destroy
matter
copper ore
copper metal
metals
conservation

Materials - none

TEACHING SUGGESTIONS:

1. Have the students read pages 265-266 and answer the questions. Teacher may paraphrase.

2. Discuss the answers thoroughly when the students have finished.

3. Suggest that some interested students prepare a report on metals besides copper that are used extensively by modern societies. Iron, aluminum, chromium, zinc, lead, and silver are possibilities. Reports should focus on sources of the metal, its uses, and supply problems, if any now exist. These students could then present their findings to the class.

DESIRED LEARNING OUTCOME: The students should be able to list some resources that society is consuming in great quantities and list some wastes society is producing in great quantities.

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DEVELOPMENT: Lesson Cluster 4B-1 Conserving Resources
Page T-460/S-267 Kinds of Resources (25-30 min.)

PURPOSE: To distinguish between naturally renewable, recyclable, and nonrenewable resources.

ADVANCE PREPARATION:

Language Cards/Key Signs
resources
recycled
polluted
renewable
nonrenewable

Background Information: Before we can talk sensibly about conserving resources, we must distinguish between the kinds of resources we have. That is the purpose of this lesson. The categories discussed are nonrenewable, recyclable, and naturally renewable resources.

A fourth category, replaceable resources, is also possible. For example, wood has been replaced by metals and plastics in many cases. But replacing one resource with another does not provide a permanent solution to the problem of finite resources. The substitute materials are also finite. For example, the depletion of our hardwood forests has fostered the increased use of plastics by the furniture industry. But plastics come from oil, which all nations are trying to conserve.

Materials - large poster size copy of the chart "Natural Resources Used by People" (see below) to be displayed in room during this cluster
-any material or product that has been made from recycled material; this is usually marked on the product or package

TEACHING SUGGESTIONS:

1. Have the students read page 267 and answer the questions. Teacher may paraphrase.

2. Discuss the answers to the questions and use the information to begin a Conservation Chart similar to the one shown here. You can add other items to the chart as the class goes through this cluster of activities.

NATURAL RESOURCES USED BY PEOPLE

Resources	Type	Uses	How to Conserve
copper	nonrenewable	wire, pipes	recycle

3. Show the class an item you were able to find that was made from recycled material.

4. Consider with the class any material that the school throws away in great quantity. For example, especially sheets used only on 1 side; cafeteria items such as plastic trays, jars, egg cartons. As a class try to think of ways these and other items may be used again in different ways and not just thrown away. Emphasize that reusing an item is a form of recycling. This exercise could develop into a school-wide recycling and anti-waste campaign.

DESIRED LEARNING OUTCOME: The students should be able to distinguish between naturally renewable, recyclable, and nonrenewable resources and give an example of each.

****

ENRICHMENT: Lesson Cluster 4B-1 Conserving Resources
Page T-461 Recycling Water (30-40 min.)

PURPOSE: To investigate how water from rivers and oceans is recycled into fresh rainwater. This lesson does not appear in the student text.

ADVANCE PREPARATION:

Language Cards/Key Signs
recycling
water cycle
rainwater

Background Information: The water cycle is the sequence of events in which rainwater falls on the land; flows into rivers, lakes and oceans; and evaporates into the air to fall as rain again. As water vapor evaporates, it leaves behind dirt particles, salt, and other substances it has collected. This process is a form of natural purification. Unfortunately, as the rain falls, it may be dirtied by particles of air pollution, so rainwater is seldom really pure.

Materials -plastic boxes, such as sweater boxes, or rectangular aquariums
-plastic wrap
-soil
-small bowls or shallow cups
-metal washers or small weights
-salt

Assemble the necessary materials for this activity before the class period. You can use the model ecosystems from the preceding cluster, plants and all, if students constructed them from sweater boxes or rectangular aquariums. Plastic-bag or gallon-jar ecosystems won't work for this activity.

TEACHING SUGGESTIONS:

1. Review the water cycle described on pages 214 and 267 with the class.

2. Make a drawing on the chalkboard like the one shown in Figure 4-1. Explain to the students that they will make a model showing how water is purified in nature.

3. Make the materials available to the class and explain their use. The container should be raised at one end with a book or block. A shallow cup (A) or bowl at the lower end will contain water. A second cup (B), positioned under the sagging, weighted plastic wrap, will collect condensing droplets.

4. Have some groups of students fill the A cups with water that has a little dirt mixed in to make it muddy like river water. Have the other groups add a teaspoon of salt to their A cups, simulating ocean water.

5. Instruct students to set their water-recycling systems in a sunny or bright spot in the room. Solar energy drives the water cycle.

6. The next day they can uncover the boxes and take out the B cups. Is the water in them clean or dirty? The students who evaporated "ocean water" can dip in a clean finger tip and taste the "rainwater" they collected to see if it is salty.

7. Ask students why some places on Earth might not get much rainfall and suffer water shortages as a result. Have them look to their models for possible answers. In the model, water only falls under the washer. Various meteorological phenomena affect where rain falls. Review the influence of mountains described on page 216,

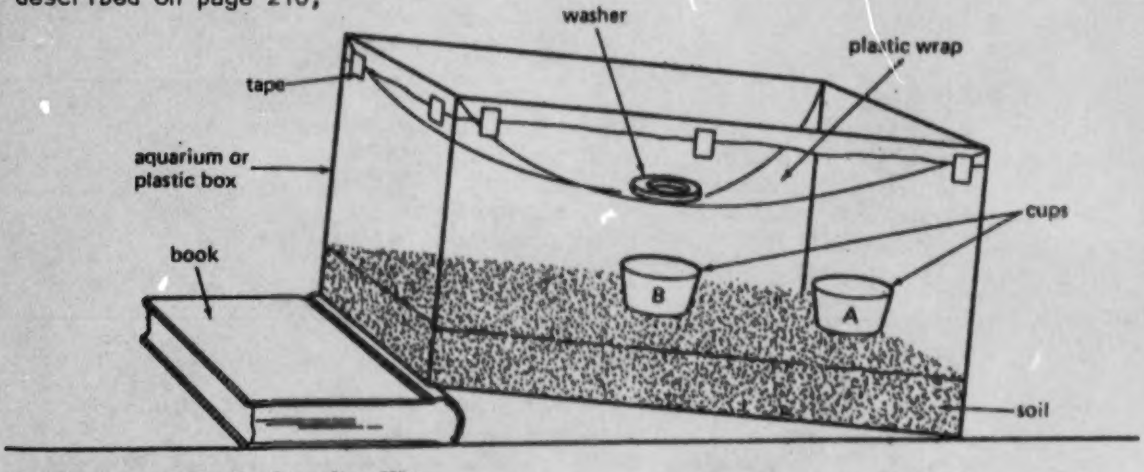

Figure 4-1. *A Setup for Recycling Water.*

DESIRED LEARNING OUTCOME: The students should be able to describe how water is purified in nature.

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DEVELOPMENT: Lesson Cluster 4B-1 Conserving Resources
Page T-462/S-268 Why Conserve Resources? (20-25 min.)

PURPOSE: To further develop the need to conserve resources and the consequences of not conserving.

ADVANCE PREPARATION: Materials - none

Language Cards/Key Signs
conserve
resources
oil
copper
plastic
create
ecosystems

TEACHING SUGGESTIONS:

1. Have the students read pages 268-269 and answer the question. Teacher may paraphrase. Discuss the answers to the question. Stress the effects on ecosystems of obtaining natural resources and fear of shortages as reasons for conserving natural resources.

2. During reading have students name all the things in the school and general environment that are made of plastic. They should be reminded, if necessary, that their hearing aids are made partly from plastic. This discussion should help them to understand the impact of a plastic shortage.

3. Add oil to the Natural Resources Chart begun earlier in this cluster.

DESIRED LEARNING OUTCOME: The students should be able to list several reasons for conserving natural resources.

* * *

DEVELOPMENT: Lesson Cluster 4B-1 Conserving Resources
Page T-464/S-270 How Can We Conserve? (20-30 min.)

PURPOSE: To develop ways our society can conserve resources.

ADVANCE PREPARATION:

Language Cards/Key Signs
conserve
resources
electric
nonreturnable
conservation

Background information: The examples of resources used in this lesson have been chosen to highlight several important characteristics of our consumer-oriented society. One characteristic is private ownership of tools and other items that the owners use infrequently and could conceivably share. A second characteristic is the proliferation of gadgets and labor-saving devices. Another characteristic is the tendency of industry to create nonreusable products. Finally, municipal governments generally attempt to get rid of garbage and trash rather than salvage any of the energy or materials in it. (Relatively few communities recycle glass and metals from their trash, and very few plants have been built to supply towns with heat by burning garbage, although the technology is available.)

In each of these instances, the students can think of numerous ways that resources could be conserved and numerous reasons why most people and local governments don't practice much conservation.

Materials - none

TEACHING SUGGESTIONS:

1. Instruct the students to read page 270 and answer the questions at the end of the reading. Teacher may paraphrase.

2. Discuss the questions, giving students the opportunity to think of ways to conserve resources in their own lives.

3. Encourage students to think of reasons, other than ignorance or indifference, why people usually don't practice conservation. It often appears that being wasteful is more convenient and less expensive than conserving, at least in the short run.

4. Add students' suggestions to the chart constructed earlier in this cluster, if you wish.

5. Extend this lesson to include some practical problems for interested students to investigate, if they wish:
   a) How much water is wasted from aleaky faucet?
   b) How much heat is lost in terms of wasted fuel oil from an uninsulated or poorly insulated house?
   c) How much gasoline is wasted in cars with poor fuel economy?

DESIRED LEARNING OUTCOME: The students should be able to list several ways to conserve natural resources in everyday activities.

****

APPLICATION: Lesson Cluster 4B-1 Conserving Resources
Page T-465/S-271 Managing With Less (30-35 min.)

PURPOSE: To discover the automobile's use of natural resources and ways to conserve these resources.

ADVANCE PREPARATION: Materials - none

TEACHING SUGGESTIONS:

1. Have the students read page 271 and answer the questions They should be able to refer to the Natural Resources Chart prepared earlier in this cluster.

Language Cards/Key Signs
managing
commuters
ecosystems
conserve

2. Review their answers with them.

3. As an alternative to having students individually answer the questions, you might want to divide the class into two groups, Have one group prepare a bulletin board display that addresses the second question. Have another group prepare a display focusing on questions 1 and 3. For example, students could construct a highway scene with large arrows pointing to the resources used and a brief word or statement at the end of the arrow indicating ways to conserve.

DESIRED LEARNING OUTCOME: The students should be able to list the resources used by automobile commuters and suggest ways to conserve these resources.

****

EVALUATION: Lesson Cluster 4B-1 Conserving Resources
Page T-466/S-272 Resources (20-20 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Proposing ways to conserve valuable resources.
2. Distinguishing between naturally renewable, recyclable, and nonrenewable resources.

TEACHING SUGGESTIONS:

1. Have the students read page 272 of the text and write down their answers to the questions.

2. Review the answers thoroughly. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 6 Unit 4 Energy and Ecosystems

Part B Resources and Problems, Lesson Cluster 4B-2

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-472	Introduction	Nothing Is Ever Really Lost	20-30 min.
T-474	Development	Water Pollution	30-40 min.
T-476	Development	Air Pollution	40-50 min.
T-480	Development	Managing Town Dumps	30-40 min.
T-482	Application	What Should We Do About Throwaways?	20-30 min.
T-483	Evaluation	Trash Cans	20-30 min.

FILMSTRIP INFORMATION: Filmstrip Set XXI, Ecological Interactions, is appropriate for use in this unit.

INTRORUCTION: Lesson Cluster 4B-2 Everything Goes Someplace
Page T-472/S-273 Nothing Is Ever Really Lost (20-30 min.)

PURPOSE: To introduce the underlying reason for pollution.

ADVANCE PREPARATION:

Language Cards/Key Signs
matter
destroyed
disposing
waste matter
dumps
trash heaps
pollution

Background Information: All the activities of living things that use materials and energy produce waste products. Wastes are inevitable. In the usual course of events, materials are cycled through ecosystems so that the waste products of one population become the raw materials of another population. People, however, often produce more wastes than the natural environment can use and produce many wastes that act as poisons, not raw materials, for other organisms.

Materials - none

TEACHING SUGGESTIONS:

1. Have the students read page 273 and answer the questions at the end of the reading.

2. During the discussion of the questions, you might want to prepare a chart on the chalkboard of the materials with which people pollute the environment. You could organize the list by water, air and land pollution. List the sources of the pollution in each area and ways to reduce that pollution. As the lessons in this cluster progress, you can add to the chart.

DESIRED LEARNING OUTCOME: The students should be able to explain why some pollution is unavoidable and give a few examples of the sources of pollution.

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DEVELOPMENT: Lesson Cluster 4B-2 Everything Goes Someplace
Page T-474/S-274 Water Pollution (30-40 min.)

PURPOSE: To develop the sources of water pollution and its effects on lakes, rivers, and oceans.

ADVANCE PREPARATION:

Language Cards/Key Signs
water pollution
sewage
poisonous
decomposers
oxygen

Background Information: This lesson classifies two kinds of pollution that affect water. The first kind is generally poisonous to life. This material usually comes from industrial waste products that get into the water and accumulate to a deadly level. These poisonous materials include mercury, lead, various pesticides, and a number of other chemical waste products. During the normal biological life processes in an ecosystem, these waste products are not broken down (or degraded); therefore these substances are called nonbiodegradable. The other type of pollution is not in itself poisonous. Rather, this material leads to an excessive amount of life in an aquatic ecosystem. The end result is that there is not enough oxygen in the water to support life. Because these pollutants are broken down in the water, they are called biodegradable.

Even relatively small amounts of poisonous materials can pollute water. But it takes large amounts of sewage, food wastes, and other organic wastes to overload a good-sized lake or river.

As with other activities in this part, local problems and practices are given special emphasis.

Materials - none

TEACHING SUGGESTIONS:

1. Have the students read pages 274-275. Teacher may paraphrase.

2. You may want to divide the class into several groups. One group can get in touch with the area water department and find out how local waters are treated. The health department can answer another group's questions about local water quality. If there is a recreation department with jurisdiction over a local beach, a third group can contact it. A fourth group might try library research.

3. The class may want to arrange visits under your supervision to these town departments. Otherwise, one person in each group, armed with a list of questions the group has prepared, can interview an official over the phone.

4. Have the students report to the class on their findings about local water pollution problems, if there are any. There are in most towns.

DESIRED LEARNING OUTCOME: The students should be able to describe examples of water pollution and discuss the causes.

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DEVELOPMENT: Lesson Cluster 4B-2 Everything Goes Someplace
Page T-476/S-276 Air Pollution (50 min.)

PURPOSE: To investigate the amount and sources of one type of local air pollution.

ADVANCE PREPARATION:

Background Information: Air pollutants can be classified as gases or particles (sometimes called particulate matter). Dangerous gases from car exhausts and furnaces are not easily investigated by students, but particles are. They can be collected, looked at under magnifying lenses, amounts compared, and so on.

Language Cards/Key Signs
- air pollution
- dust
- pollen
- car exhaust
- Dust-E-Cube

Materials -light cardboard or file cards
-scissors
-transparent tape
-string; eqch piece 12" long
-magnifying lenses
-patterns for Dust-E-Cube from Appendix L
-glue
-compass or local map
-prepare a model of Dust-E-Cube for the class

TEACHING SUGGESTIONS:

1. Have the students read page 276 and discuss air pollution generally. Ask them what air pollution is. How do they know the air is polluted? Can they always see air pollution? Smell it?

2. Have the students read the instructions on pages 277-278. Discuss the procedure with them and then show them a complete Dust-E-Cube. If you duplicate the pattern in Appendix L, students can glue it onto a piece of cardboard and cut it out. Otherwise, they will have to trace the pattern on page 277 and glue it into their cardboard.

3. Distribute the materials and instruct the students to follow the directions in the text to make their own cubes.

4. Have the students hang their cubes in various places around the school, its grounds, and other places in the community, if this is feasible.

5. Be sure to emphasize the need to indicate North on one side of the cube and to hang the cube with this side toward the north. A compass or local map will be helpful. Then with the data available, have the students answer the questions on page 278.

6. After two or three days have students retrieve their Dust-E-Cubes and examine them. Magnifying lenses will be helpful. Then with the data available, have the students answer the questions on page 278.

7. During the discussion students should share their results and try to determine where the dirtiest and cleanest places in the community might be and why.

8. Emphasize that this is a test of only one form of air pollution.

9. Add the information gained here to the pollution chart begin earlier, if you wish.

10. OPTIONAL: Have students divide the tape into four equal-sized sections and count the number of particles in one section using magnifying lenses. Then they can multiply that number by 4. That will give them a quantitative indicator of the particles in the air at that location for the time period the cube was up. This is a simplified version of the method used by various environmental organizations and government agencies to measure the amount of particlate matter in the air. If students keep records of this measurement over long periods of time, they may see patterns develop. Some students might want to undertake a study of this kind.

DESIRED LEARNING OUTCOME: The students should be able to identify areas in their school and neighborhoods that are high and low in particles of air pollution and suggest reasons for the differences between the areas.

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DEVELOPMENT: Lesson Cluster 4B-2 Everything Goes Someplace
Page T-480/S-279 Managing Town Dumps (30-40 min.)

PURPOSE: To investigate which waste products and materials can be decomposed and which are not biodegradable.

ADVANCE PREPARATION:

Background Information: Society produces mountains of garbage and trash everyday. Much of this material can be broken down by decomposers and returned to the soil. As the students will find in this lesson, food, paper wastes, and other organic material are readily broken down by soil microorganisms. Much garbage is not biodegradable, however. Metals, plastics, and glass belong in this category. Recycling the nonbiodegradable materials and burying the organic materials in a sanitary landfill would enable a town to help conserve resources and minimize pollution problems. Unfortunately, few towns have the equipment to economically salvage valuable materials from garbage for recycling. And most towns do not have land set aside for sanitary landfills. However, more and more towns are moving toward these solutions to their solid waste disposal problems.

Language Cards/Key Signs
- dumps
- garbage
- landscape
- trash
- sanitary landfill
- compost pile

Materials -plastic trays (try to re-use ones from cafeteria or grocery store)
-garden soil
-garbage (vegetable matter, paper, metal, plastic scraps)
-unlined paper and pencils

Have the students bring in small pieces of trash and garbage on the day of the lesson. Kitchen scraps are fine, but should consist of vegetable matter only, as pieces of meat are apt to stink as they rot. The soil you bring in should be garden, lawn, or woodland soil, not sterilized potting soil or subsoil. These latter soils will not contain the worms and microorganisms needed to decompose the organic wastes.

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TEACHING SUGGESTIONS:

1. Have the students read the instructions on pages 279 and 280 for setting up their own sanitary landfills. Teacher may paraphrase.

2. Discuss the procedure with them.

3. Allow them to set up their landfills, reminding them that the soil should be damp, but not muddy.

4. The containers can be kept anywhere in the room where they will not be underfoot. They should not smell if directions have been followed and the trays are not overloaded with food wastes. Avoid sunny locations where the soil may dry out. Use Identification Card as a label.

5. Instruct the students to dig up their landfills in a week or two and see what remains of the buried wastes.

6. Discuss the questions with them and then add this information on land pollution to the chart started earlier in this cluster.

DESIRED LEARNING OUTCOME: The students should be able to list some waste products that are biodegradable and some that are nonbiodegradable.

****

APPLICATION: Lesson Cluster 4B-2 Everything Goes Someplace
Page T-482/S-281 What Should We Do About Throwaways? (20-30 min.)

PURPOSE: To investigate the pollution problems associated with throwaways and to consider various ways to solve this problem.

ADVANCE PREPARATION: Materials -examples of throwaway items (soda cans, beer bottles, cans, etc.)

Language Cards/Key Signs
throwaways
drink containers
ballpoint pens
portable radios

TEACHING SUGGESTIONS:

1. Have the students read page 281 and answer the questions. Teacher may paraphrase.

2. Discuss the questions with the students and add this source of pollution to the chart begun earlier in the cluster. Allow the chart to stay on the chalkboard until the day of the evaluation lesson. It should be erased before students do the Wrap Up.

3. Have the students bring to class examples of throwaways and prepare a display table or bulletin board with these items, if you wish. For each item you could ask students to think of an alternative to the throwaway.

DESIRED LEARNING OUTCOME: The students should be able to list several items that are throwaways, explain how these items contribute to pollution, and suggest ways to substitute a less polluting alternative.

****

EVALUATION: Lesson Cluster 4B-2 Everything Goes Someplace
Page T-483/S-282 Trash Cans (20-30 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Listing the kinds of wastes people create that pollute the air, water, and land.
2. Identifying problems caused by pollution.
3. Explaining how recycling, sanitary landfills, and composting can reduce garbage disposal problems.

TEACHING SUGGESTIONS:

1. Have the students answer the questions on page 282 on a sheet of notebook paper. If the students find the analogy of air, water, and land to trash cans confusing don't use it.

2. Review the questions thoroughly with them. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objective for the cluster and is ready to go on to the next cluster.

****

Part B Resources and Problems, Lesson Cluster 4B-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-488	Introduction	We All Cause Pollution	20-30 min.
T-492	Enrichment	Classroom Waste	30-35 min.
T-489	Development	Pollution Can Be Reduced	30-35 min.
T-490	Development	We Are All Affected By Pollution	20-30 min.
T-493	Application	Watch Out for Yourself	20-30 min.
T-494	Evaluation	Clean and Dirty	20-30 min.

B. MATERIALS: Add the following to the list on page T-485 -
- pictures of lakes, beaches, etc. that have been polluted by oil spills and industrial waste; also pictures of smog as it settles over a city. National Geographic, Time Magazine are possible sources.

FILMSTRIP INFORMATION: Filmstrip Set XXI, Ecological Interactions, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4B-3 Our Part In The Pollution Problem
Page T-488/S-283 We All Cause Pollution (20-30 min.)

PURPOSE: To consider various ways to reduce the amount of waste people contribute to the environment.

Language Cards/Key Signs
pollution
waste
environment
transportation

Identification Cards

ADVANCE PREPARATION:

Background Information - There are many things people can do to reduce their personal contribution to the pollution problem. For example, we can use lesser amounts of polluting substances. We can substitute substances that are less polluting for the ones we ordinarily use. We can dispose of wastes more carefully. And we can change our habits and not use some goods and services.

There is no end to the ways a class can think of for reducing pollution. Not all ways, however, are likely to be practical or popular.

Materials - paper and pencils

TEACHING SUGGESTIONS:

1. Have the students read page 284 and answer the questions. Teacher may paraphrase.

2. Discuss their answers. It will be most effective to make a master list on a chalkboard or bulletin board.

3. As an optional exercise, have the students choose an industry such as clothing or record making and find out, with the help of the library or a local resource person, some of the wastes the industry produces.

4. For the Enrichment that follows this lesson, please see T-492.

DESIRED LEARNING OUTCOME: The students should be able to list several ways that they directly and indirectly contribute pollution to the environment.

****

ENRICHMENT: Lesson Cluster 4B-3 Our Part in the Pollution Problem
Page T-492 Classroom Waste (30-35 min.)

PURPOSE: To investigate how much solid waste classrooms produce. This lesson does not appear in the student text. This lesson should follow (1) We All Cause Pollution.

ADVANCE PREPARATION:

Background Information - This activity is a good complement to the introduction since it focuses on magnitude, while the introduction focused on kinds of wastes. This activity is useful also in showing how much waste is created by supposedly "clean," everyday activities such as school work, as opposed to factories, which are usually considered the villains.

Materials - paper and pencils
large plastic garbage with ties
bathroom scale or scale from nurse's office

Inform the principal and the janitor that you will be collecting classroom wastes every day for a week. Inform the janitor that you don't want the contents of wastebaskets or floor sweepings removed at the end of each day. Provide a large plastic bag for the janitor to fill with each day's sweepings, or have the class sweep the floor and collect the dirt in a bag.

TEACHING SUGGESTIONS:

1. Inform the class that it is going to undertake a quantitative study of solid wastes by collecting all the dirt and trash it produces for a week.

2. Provide large plastic garbage bags for waste collection. If you have the same class all day, students can dump the room's wastebaskets into the bags at the end of each day. If you have several classes a day, you may wish to have each class use its own plastic bag.

3. At the end of the week, have students weigh the wastes that have been collected. The easiest way may be to have a student holding a trash bag get weighed and then subtract his or her weight without the trash.

4. Have students estimate how much waste the class will produce in a school year by multiplying the week's wastes by the number of weeks in the school year.

5. Have students estimate how much waste the whole school produces in a school year.

6. Call the Department of Sanitation and find out how the school's wastes are disposed of.

DESIRED LEARNING OUTCOME: The students should be able to estimate how much solid waste a single classroom produces.

****

DEVELOPMENT: Lesson Cluster 4B-3 Our Part in the Pollution Problem
Page T-489/S-284 Pollution Can Be Reduced (30-35 min.)

PURPOSE: To consider the various direct and indirect ways people add wastes to the environment.

ADVANCE PREPARATION:

Background Information - Almost everyone thinks that pollution is something businesses and factories cause. We are not supposed to be responsible for that. But of course that isn't true. We all add wastes to the environment. And the businesses and factories that cause pollution do so while making things for us to use. It is important for the class to learn and remember Pogo's famous statement, "We have met the enemy, and he is us."

Language Cards/Key Signs
reduced
devices
smokestack
soot
personal

Identification Cards

Materials - paper and pencils

TEACHING SUGGESTIONS:

1. Have the students read page 283 and answer the questions. Teacher may paraphrase.

2. Review the questions with the students. Have them consider whether their suggestions are practical and whether they would be population or unpopular.

3. Ask students how much they are willing to spend and how much extra work they are willing to do to reduce pollution. For example, are they willing to use returnable drink containers instead of nonreturnable containers? Would they be willing to buy clothing made of wood and cotton that costs more than comparable clothing made of synthetics, which cause more pollution during manufacture? Are they willing to do more things by hand and less by machine? Do they think most other people would agree with them? Accept all their answers without moralizing. The point of these questions is for the students to determine what their own values are on these subjects.

DESIRED LEARNING OUTCOME: The students should be able to state various ways they can reduce the amount of waste they add to the environment.

****

DEVELOPMENT: Lesson Cluster 4B-3 Our Part in the Pollution Problem
Page T-490/S-285 We Are All Affected by Pollution (20-30 min.)

PURPOSE: To develop the idea of the health hazards associated with pollution.

ADVANCE PREPARATION:

Background Information - Students usually regard polluation as mainly a matter of litter. They see it as an aesthetic problem, i.e. it's ugly, rather than a health problem. Without needlessly getting into details of specific diseases associated with specific kinds of pollution, the lesson should make it clear that pollution is very dangerous to your health.

Some places are clearly unhealthier than others. But no place is free of pollution. Chemicals are carried by the air and oceans to places far from where they were first used. Towns that pollute relatively little are often downstream and downwind from heavy polluters. People who move to suburbs to escape the city commute there to work each day.

Language Cards/Key Signs
affects
health
breathe
coughing
sneezing
lung disease
poisonous

Identification Cards

Materials - pictures of lakes, beaches, etc., that have been polluted by oil spills, industrial wastes, etc. and pictures of smog settled over a city like Los Angeles. National Geographic, Scientific American, Time are possible sources.

TEACHING SUGGESTIONS:

1. Have the students read pages 285-286 and answer the questions. Teach may paraphrase.
2. Review the questions with the students, emphasizing that pollution is dangerous and more than an eyesore.
3. As an optional exercise, you might have a few interested students report on some examples of pollution problems that have posed a serious health hazard, or have the students keep a record of events that they hear about in the news that show how various forms of pollution pose health hazards.

DESIRED LEARNING OUTCOME: The students should be able to state several ways in which pollution is a health hazard.

****

APPLICATION: Lesson Cluster 4B-3 Our Part in the Pollution Problem
Page T-493/S-287 Watch Out For Yourself (30-35 min.)

PURPOSE: To apply knowledge of the dangers of pollution to classifying play areas in terms of safety.

ADVANCE PREPARATION: Materials - none.

TEACHING SUGGESTIONS:

1. Instruct the students to read the questions and study the illustrations on page 287. Teacher may paraphrase.

Language Cards/Key Signs
polluted
somewhat polluted
badly polluted

Identification Cards

2. After they answer question 1 about both play areas, have them think very carefully about where they play. Have them list the areas where they play and the kinds of pollution they might encounter there. They should then classify their play area as instructed in question 3.

3. Encourage students to report any obvious dangers in any playground to the proper authorities. The students should understand that they have a right to a safe play area in their community.

DESIRED LEARNING OUTCOME: The students should be able to use their knowledge of pollution to classifying the safety of their play areas.

****

EVALUATION: Lesson Cluster 4B-3 Our Part in the Pollution Problem
Page T-494/S-288 Clean and Dirty (30-35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Explaining how people's daily activities can add pollution to the environment.
2. Describing ways to reduce the pollution they personally cause.
3. Stating several health hazards caused by pollution.

ADVANCE PREPARATION:

Background Information - Ironically, much pollution is caused by people trying to clean up their immediate environment. Detergents get into local waters and cause water pollution. Getting rid of dirt and trash around the house means putting the trash someplace else.

To reduce this unintended pollution various actions are possible. Using soaps or detergents that do not contain phosphates (which act like fertilizers for aquatic plants) is preferable to using ordinary detergents. Also, one should use only as much cleanser as is necessary. Glass and metal cans can be separated from household garbage and taken to recycling centers. Burning leaves creates air pollution, but composting them does not. Vacuum cleaners should be turned off when not in use to avoid wasting electricity.

While these various efforts at reducing pollution can have a definite effect, the class should not get the impression that they will solve the so-called "pollution problem." A society that consumes large amount of materials and energy will always produce large amount of pollution.

TEACHING SUGGESTIONS:

1. Instruct the students to read the two problems on page 288 and answer the question on a sheet of notebook paper.

2. Discuss the questions thoroughly with the students, emphasizing the need for awareness of how we all pollute our ecosystems so that we can then take steps to reduce the pollution we cause.

If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 6 Unit 4 Energy and Ecosystems

Part C Using Energy Wisely, Lesson Cluster 4C-1

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-500	Introduction	Electricity in the Classroom	30-40 min.
T-502	Development	Electric Use at Home	20-30 min.
T-503	Development	Reading Your Meter	40-50 min.
T-504	Application	Conserving Electricity	20-30 min.
T-506	Evaluation	Using and Saving Watts	30-40 min.

B. MATERIALS: Add the following to the materials list on page T-497:
-a ditto showing several electric meters with different readings, as on page S-293.

FILMSTRIP INFORMATION: Filmstrip Set XXI, Ecological Interactions, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4C-1 Using Electricity
Page T-500/S-290 Electricity in the Classroom (30-40 min.)

PURPOSE: To introduce the uses of electric energy and the units in which it is measured.

ADVANCE PREPARATION: Materials - On the day of this lesson, try to have as many electric appliances, bulbs, slide projectors, and so forth as possible in the room, so the students can easily obtain the information required.

Language Cards/Key Signs
electricity
energy
convenient
transform
electric energy
watt-hours
60 watt bulb

Identification Cards
(label each electrical appliance, etc.)

TEACHING SUGGESTIONS:

1. Have the students read pages 290-291. Teacher may paraphrase. Then ask them to copy the chart on page 291 onto a sheet of notebook paper.

2. Have them write down as many items in the classroom as they can that use electric energy.

3. Allow them to investigate the items themselves to determine their wattage, or, depending upon the number of students in the classroom, you may assign certain students to investigate an item and call out the wattage to the entire class.

4. Discuss with the class the length of time each item may be used. Come to some

general agreement on these times, so that all students are using the same figures.

5. Have the students complete the data sheets and then help them calculate the watt-hours of the first two items on their list. Let them finish the list on their own.

6. Have students answer the questions. You might suggest that some interested students estimate the use of electricity by the entire school.

DESIRED LEARNING OUTCOME: The students should be able to list the various uses of electricity in the classroom and to make an estimate of how much electric energy is used in the classroom each day.

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DEVELOPMENT: Lesson Cluster 4C-1 Using Electricity
Page T-502/S-292 Electric Use at Home (30-35 min.)

PURPOSE: To investigate personal use of electric energy in the home or school.

ADVANCE PREPARATION: Materials - paper and pencil

Language Cards/Key Signs
electric energy

TEACHING SUGGESTIONS:

1. Have the students read page 292 and make another copy of the chart on page 291.

2. Ask them to take the charts home and fill them in for the next class period, or as an alternative, the students may use their dormatory school kitchen, workshop, etc., as the source for this information.

3. Compare the students' measurements of the watt ratings of the various appliances. (Note: All refrigerators do not use the same number of watts, nor do all toasters, hair dryers, and other appliances.) Also compare the estimated times each appliance is used, since these figures will vary among students. If the school was used instead of each student's home, this step will probably not apply.

4. Have the students answer the numbered questions and compare their answers with their classmates'.

DESIRED LEARNING OUTCOME: The students should be able to list the various electric products in their homes and tell how much electric energy they use.

****

DEVELOPMENT: Lesson Cluster 4C-1 Using Electricity
Page T-503/S-293 Reading Your Meter (40-50 min.)

PURPOSE: To calculate the amount of electric energy used in the home.

ADVANCE PREPARATION: Materials
- paper and pencils
- find out where the electric meter is in the school and get permission for class to read it
- make a picture of the meter on page 293 on the board
- make a ditto showing several meters with different readings

Language Cards/Key Signs
meter
electricity
electric meter
kilowatt hours
watt-hours
kilowatt
watt
dials
metered amount

Identification Cards
electric meter

TEACHING SUGGESTIONS:

1. Have the students read page 293 and review with them the procedure for reading meters. Use the drawing of the meter on the board as an example during the explanation. Label it with the Identification Card.

2. Have the class complete the practice ditto of different meters. This can be done in class and/or for homework.

3. If possible, ask them to read their meters at home, as described in the text, over a two-day period. Be sure to remind them of this assignment on the second day. Students who live in apartment houses may have to ask their building superintendents to show them where their meters are.

4. If reading the home meter is not possible, only have the students answer question number 3 in text. Use the Identification Card to label the meter while its being read.

5. Discuss with the students their meter readings. It may be necessary, if some did not read the meter correctly, to repeat the assignment.

6. Have the students answer the questions, and then discuss the answers with them.

7. As an optional exercise, you might have the students convert their watt-hour measurements in the two preceding lessons into kilowatt-hours. Also have them calculate the cost of school and home electrical use per day, week, or month.

DESIRED LEARNING OUTCOME: The students should be able to determine the amount of electric energy used in their homes by reading their electric meters.

* * *

APPLICATION: Lesson Cluster 4C-1 Using Electricity
Page T-504/S-294 Conserving Electricity (20-30 min.)

PURPOSE: To devise ways of conserving electric energy.

Language Cards/Key Signs
conserving aluminum industry

ADVANCE PREPARATION:

Background Information: Some utility company officials have estimated that conservation efforts can reduce an average family's electric usage by 20-25%. This is obviously a substantial savings in energy and money. However, most electric energy is used by our society for industrial purposes. Accomplishing a significant overall reduction in energy usage is therefore beyond the power of individuals and families. It is up to business.

Materials -paper and pencils

TEACHING SUGGESTIONS:

1. Have the students read pages 294-295 and answer the questions. Teacher may paraphrase.

2. Discuss the students' suggestions and list them on the chalkboard.

3. Extend the discussion, if you wish, by estimating what each action listed above might save in kilowatt-hours or money. For example, if a family of four decided to abandon the use of a hair dryer that uses 1000 watts of energy and is used by each member of the family for 5 minutes per day, that would be 20 minutes per day, or 6000 minutes (10 hours) per month. If the kilowatt-hour cost was 4 cents, that would be a 40-cents saving per month. Obviously, few families would be interested in saving $.10 a month per family member by giving up daily use of a convenience. Discuss the difficulty of getting people to reduce their electric energy comsumption.

DESIRED LEARNING OUTCOME: The students should be able to list ways to conserve electric energy.

****

EVALUATION: Lesson Cluster 4C-1 Using Electricity
Page T-506/S-296 Using and Saving Watts (30-40 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Comparing the relative amounts of electricity used by various appliances.
2. Describing ways to conserve electricity in the use of various appliances.
3. Explaining how recycling products can conserve energy.
4. Explaining why durable products conserve energy over short-lived products.

TEACHING SUGGESTIONS:

1. Have the students read page 296 and answer the questions on a sheet of notebook paper. Teacher may paraphrase.

2. Review the questions with them when they have completed the assignment. If a student correctly answers most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and may go on to the next cluster.

Part C Using Energy Wisely, Lesson Cluster 4C-2

A. CLUSTER OUTLINE:

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-512	Introduction	You Use Energy	20-30 min.
T-517	Enrichment	Fuel Consumption	20-30 min.
T-514	Development	Big Energy Suppliers	40-45 min.
T-518	Development	Environmental Costs	20-30 min.
T-520	Development	More Energy with Less Damage	20-30 min.
T-522	Application	Making a Solar Heater	40-50 min.
T-523	Evaluation	Supplies and Costs	30-40 min.

NOTE: The Enrichment lesson is optional since not all children will have access to a family car.

Make arrangements to visit a power plant, coal mine, wind mill, nuclear plant and a facility that uses a solar collector.

B. MATERIALS: Add the following to the materials list on page T-509:
-pictures of wind mills and solar heaters (collectors)

FILMSTRIP INFORMATION: Filmstrip Set XXI, Ecological Interactions, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4C-2 Energy Sources and Problems
Page T-512/S-297 You Use Energy (20-30 min.)

PURPOSE: To record all the forms of energy in the students' environment.

ADVANCE PREPARATION: Materials - paper and pencils

TEACHING SUGGESTIONS:

1. Have the students read pages 297-298 and make two copies of the chart on page 298 on a sheet of notebook paper. They should label one chart "Personal Energy Use" and the second, "Observed Energy Uses."

2. Review the uses of electricity considered during the previous cluster. Ask the students if there are any other forms of energy used in the classroom and what their sources might be. Add these uses to the "Personal Energy Use" chart.

3. Instruct the students to take the "Personal Energy Use" chart home or to their dorm and to fill it out for one day.

Language Cards/Key Signs
electric energy
coal furnaces
gas stoves
oil hot water heaters
gas
energy source
Personal Energy Use
Observed Energy Use

4. On the next day have students take the second chart with them and fill it out. Both charts should be ready for the following class meeting.

5. Discuss the students' findings during the following class meeting. Record the various energy uses and sources on the board and determine the most common ones.

DESIRED LEARNING OUTCOME: The students should be able to list the forms of energy used in their environment.

****

ENRICHMENT: Lesson Cluster 4C-2 Energy Sources and Problems
Page T-517 Fuel Consumption (20-30 min.) optional

PURPOSE: To measure the fuel consumption and fuel consumption rates of cars. This lesson does not appear in the student text. This lesson should follow (1) You Use Energy.

ADVANCE PREPARATION: Materials -paper and pencils

Language Cards/Key Signs
fuel consumption
odometer
gallons per mile
liters per kilometer

TEACHING SUGGESTIONS:

1. Inform the students there is another aspect of their families' energy consumption they can measure - gasoline for the family car. (Students whose families do not own cars can use a classmate's data.)

2. Ask the students to fill out a data sheet with these headings:
GAS TANK FILLED
DATE __________ODOMETER __________
DATE __________ODOMETER___________ GAS AMOUNT____________

Students should take the sheets home and ask the person responsible for keeping the car fueled to help fill in the needed data, To get more reliable figures, the tank should read at least half empty before it is refilled.

3. Ask students to calculate the average fuel consumption of the car for a year. To do this, divide the total gas consumption by the number of days between fillings. This calculation gives the gas consumption per day. Multiply that number by 355 days to determine annual consumption.

4. Ask students to calculate the fuel comsumption rate. To do this, subtract odometer readings to find total miles or kilometers driven for the period. Divide that number into the gallons or liters of gas used. The answer will be in gallons per mile or liters per kilometer.

5. Have the students share their information with the entire class. Discuss factors that might effect fuel consumption - for example, stop-and-go driving or open highway driving, speed of travel, and so on. Generally the following factors increase fuel consumption: heavier cars, higher speeds, more stop-and-go travel.

DESIRED LEARNING OUTCOME: The students should be able to calculate how much gas their family cars use and what the rate of fuel consumption is.

****

DEVELOPMENT: Lesson Cluster 4C-2 Energy Sources and Problems
Page T-514/S-299 Big Energy Suppliers (40-45 min.)

PURPOSE: To outline the primary sources of energy in our society.

PREREQUISITES: Ability to interpret a circle graph.

ADVANCE PREPARATION:

Language Cards/Key Signs
energy suppliers
gas
oil
coal
geothermal
solar
nuclear
generators
transformed
ecosystems

Background Information: As the graph on page 299 shows, almost all our energy presently comes from fossil fuels: coal, oil and gas. These natural resources are not being renewed by nature and are being rapidly depleted. Nuclear energy, once touted as the replacement for our dwindling fossil fuel supplies, has become the subject of fierce political fighting about its safety and economy. As a result, the construction of new reactors has slowed almost to a standstill. So-called "alternative energy sources" such as the sun, wind, and tides are likely to be utilized much more in the future. Solar energy especially is becoming more popular.

Most residential fuel consumption is for heating homes and water. A lot of the heat generated by coal, oil, gas, and electric heaters is lost to the environment when homes are poorly insulated and do not have storm windows or double-glazed windows. A simple way to demonstrate heat loss through lack of insulation is to fill two metal cans or cups with hot water. Put a thermometer in each. Wrap one cup with newspapers, cloth, or a piece of fiberglass insulation. Have students compare the temperature readings at two-minute intervals.

Design factors also influence the maintaining of cool environments in hot weather. Some buildings will require more air conditioning than others. Interested students can research ways to reduce electric consumption of air conditioners during hot weather.

Materials - none

TEACHING SUGGESTIONS:

1. Have the students read pages 299-301. Teacher may paraphrase.

2. Discuss the energy sources and the answer to the questions on page 301.

3. As an optional but highly desirable exercise, some students may want to do a bulletin board display on energy sources - how they are obtained, what their primary uses are, and, in conjunction with a future lesson in this cluster, the effect on the environment of obtaining and using that energy source. The display can make use of these headings: ENERGY SOURCE, HOW OBTAINED, PRIMARY USE, and ENVIRONMENTAL EFFECTS.

DESIRED LEARNING OUTCOME: The students should be able to list the primary sources of energy available to us and classify them as renewable or nonrenewable.

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DEVELOPMENT: Lesson Cluster 4C-2 Energy Sources and Problems
Page T-518/S-302 Environmental Costs (20-30 min.)

PURPOSE: To investigate the effects on the environment of obtaining one form of energy.

ADVANCE PREPARATION:

Background Information - This lesson shows the effects on the environment of generating electricity from coal. Remind the students that obtaining and using other sources of energy also effect the environment. For example, nuclear energy presents the problems of disposing of radio-active wastes and of exposing workers, and perhaps the general population, to radiation. Even water power (hydroelectricity, usually) in which no fuels are mined or burned is not free of environmental costs. Water power generally comes from dams across rivers, which totally change the environment where they are placed. As noted ecologist Barry Commoner has said, "There is no such thing as a free lunch."

There is no way that we can go about our lives without using energy and changing the environment. But we should always try to do the least possible damage to the environment. That is why it is important to know the total cost of using energy, not just the financial cost.

Materials - none.

Language Cards/Key Signs
environmental costs
coal mining
coal piles
strip mines
black lung disease
polluting

Identification Cards

TEACHING SUGGESTIONS:

1. Have the students read pages 302-303, study the illustrations, and answer the questions. Teacher may paraphrase.
2. Discuss the answers to the questions.
3. Allow interested students to research the environmental costs of obtaining other forms of energy. Add these to the bulletin board display begun in the previous lesson. A recent case that was publicly debated concerned the Alaskan pipeline. Interested students could report back to the class on the environmentalists' point of view and the viewpoints of the oil companies and government in the case.

DESIRED LEARNING OUTCOME: The students should be able to state some effects on the environment of obtaining and using energy.

****

DEVELOPMENT: Lesson Cluster 4C-2 Energy Sources and Problems
Page T-520/S-304 More Energy With Less Damage (20-30 min.)

ADVANCE PREPARATION: Materials - pictures of windmills and solar heaters (collectors)

Language Cards/Key Signs
damage
sunlight
wind
solar heaters
windmill
wind energy
convenience
muscle power

TEACHING SUGGESTIONS:

1. Have the students read pages 304-305 and answer the questions. Teacher may paraphrase.

2. Use pictures as examples of windmills and solar heaters. Label them with Identification Cards.

Identification Cards
windmills
solar heaters

3. Discuss the questions with them and emphasize the notion of convenience. Ask how many items of personal energy use from the list they made earlier could be considered using energy as a convenience, not as a necessity. While it is, strictly speaking, not necessary to take a bus several miles across town (one can always walk), such an energy use is not considered merely a convenience in our society. Being driven down to the corner store is another matter.

4. Have interested students add Muscle Power to the bulletin board exhibit begun earlier. Under the heading, How Obtained, they should write Food.

DESIRED LEARNING OUTCOME: The students should be able to list several forms of energy that have minimal environmental effects.

* * *

APPLICATION: Lesson Cluster 4C-2 Energy Sources and Problems
Page T-522/S-306 Making a Model Solar Heater (40-50 min.)

PURPOSE: To investigate solar heat as an alternative energy source.

PREREQUISITE: Ability to read thermometers.

ADVANCE PREPARATION:

Background Information - Solar heating is becoming popular. There are many brands of solar water heaters available. and many architects have designed homes with active or passive solar heating systems. (Passive solar heating systems do not use blowers to circulatesun-warmed air.)

Solar heating is most effective where the sun is strongest, that is, in southern latitudes. But even in northern areas, significant amounts of heat can be captured.

To get the maximum amount of energy from incoming sunlight, a solar heater should be oriented so it is perpendicular to the sunlight. The more absorbent of sunlight the collecting surface of the heater is, the more effectively it will work. Black or dark surfaces are better heat absorbers than light-colored ones.

Green houses are solar-heated buildings for plants. A person with a commercial or residential green house may be a good resource person for students to consult during this activity. The resource person can tell them of the advantages and problems of solar heat collecting designs.

Materials - paper and pencils
- styrofoam trays or shoeboxes
- dark plastic garbage bags
- tape, transparent
- thermometers
- cardboard, any size (optional)
- marbles (optional)

Language Cards/Key Signs
solar heater
styrofoam box
thermometer
dark plastic
maze
air flow

Identification Cards
solar heater

TEACHING SUGGESTIONS:

1. Have the students read page 306. Teacher may paraphrase.

2. Distribute the materials (except the thermometers) and allow the students time to prepare their heaters from the shoeboxes and trays they have brought in. Students can work in groups of two.

3. Circulate around the room while they are working and distribute the thermometers to the students as they finish their boxes. This will tend to reduce the number of broken thermometers. Be sure the thermometer bulbs are placed directly over the holes, as shown. Students should label one hole A and the other B on each heater.

4. Have the students place their boxes at various locations and record the temperatures at the beginning of each trial and after five minutes at the location. When the heaters are working, warmed air will rise through them and raise the temperature of the upper thermometer. Allow the temperatures to equalize between trials. The solar heaters will work best in direct sunlight, so you may want to conduct the data gathering outdoors if no sunlight is coming through the classroom windows.

5. Place the following chart on the board for students to copy to assist them in organizing their data.

Location of Heater	Position of Heater	Beginning Temperatures		Final Temperatures	
		A	B	A	B

In the column marked Position, note whether the heater is flat or tilted. A small sketch might be useful here. The heater works best when tilted so that the plastic is perpendicular to the sun's rays.

6. Have the students answer the questions at the end of the exercise when they have completed their observations. Discuss the questions with the class.

DESIRED LEARNING OUTCOME: The students should be able to describe various factors that affect the amount of heat produced by a solar heater.

****

EVALUATION: Lesson Cluster 4C-2 Energy Sources and Problems
Page T-523/S-307 Supplies and Costs (30-40 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:
1. Listing the primary energy sources used in North America.
2. Describing several environmental costs of using fossil fuels.
3. Stating several ways to conserve energy in homes.
4. Explaining how solar heaters work.

TEACHING SUGGESTIONS:

1. Have the students answer the questions on page 307 on a sheet of notebook paper. Teacher may paraphrase.

2. Question number 3 is optional since it is not felt that this area was adequately covered in the cluster.

3. Review the answers with the students, giving them adequate time to elaborate on the model home. If a student correctly responds to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster and is ready to go on to the next cluster.

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Level 6 Unit 4 Energy and Ecosystems

Part C Using Energy Wisely, Lesson Cluster 4C-3

A. CLUSTER OUTLINE

Page	Teaching Strategies	Lesson Title	Teaching Time Suggested
T-528	Introduction	Predicting the Future	40-50 min.
T-530	Development	Contradictions	40-45 min.
T-532	Application	What Is Really Important?	30-40 min.
T-534	Evaluation	Making Things Better or Worse	30-35 min.

B. MATERIALS: See Materials List on page T-525.

FILMSTRIP INFORMATION: Filmstrip Set XXI, Ecological Interactions, is appropriate for use in this unit.

INTRODUCTION: Lesson Cluster 4C-3 Making Choices
Page T-528/S-308 Predicting the Future (40-50 min.)

PURPOSE: To predict how people's behavior and lifestyles can affect the environment.

ADVANCE PREPARATION:

Background Information: Futurologists work by making extrapolations from the past to the future. For example, if the national birth rate has been rising for the past decade, they usually assume it will continue to do so. If pollution problems seem to be worsening, they extend the line on their graphs and assume the trends will continue.

There are two flaws with this process. One, the past is marked by change, not consistency, and the future will probably follow suit by being just as inconsistent. The second flaw involves selection of data. There is, for example, no reliable, overall index of global pollution. Many places are getting more polluted; many are getting cleaned up. Who can say whether the net tendency is toward improvement or decline? It all depends on which data you choose to focus on.

What is certain is that human behavior and lifestyles have tremendous impacts on all the ecosystems we live in. By our actions we can make things better or worse.

At this point in the unit, the students should understand the nature of ecosystems, that everything in them is interrelated, and that ecosystems are partially closed systems that must recycle resources and process wastes. The students should also understand the limited nature of our resources and the problems of pollution. They should understand how getting and using energy affects the environment. In this concluding cluster, they will bring all their knowledge of ecosystems and energy to bear on the problem of setting personal goals and priorities.

This cluster of lessons builds to a concluding activity in which students predict the likely effects on the environment of satisfying their needs and wants. By taking this large view of themselves as part of nature, not individuals outside it, they can more wisely decide which of their hopes and desires are really worthwhile.

Materials - paper and pencils

Language Cards/Key Signs
predict the future
predictors
conserve resources
natural ecosystems
pollution
recycling

Identification Cards

TEACHING SUGGESTIONS:

1. Have the students read pages 308-309 and answer the questions. Teacher may paraphrase.

2. As the class discusses the predictions, emphasize the conflicts involved in each of the lettered items. If large areas of the country are left untouched in their natural state, people who want to live, camp, or hike into those areas may not be able to. Don't they have the right to do so? For example, with several of these items you could set up little debates or skits to focus on the conflicts. Some foreseeable consequences of the lettered actions are as follows:
   a. There will be resource shortages. Lifestyles will be disrupted. Countries may go to war for materials they need. Waste disposal problems will worsen.
   b. Fuels will be depleted more quickly, leading to the situation described in (a). Pollution will increase. People will buy more products and use more energy.
   c. Ecosystem destruction will become more prevalent. The world will become less healthy for people too.
   d. Same as (c).
   e. More resources and energy will be used up. Lifestyles will become more materialistic. Pollution and waste disposal problems will worsen.
   f. Waste disposal problems will become less severe. Resource and energy shortages will be relieved. More people will get jobs doing recycling. Some people may lose jobs in mining, manufacturing, and related industries.
   g. Energy shortages will be relieved. Pollution problems will be reduced. People may become more physically active, if they conserve energy by reducing their use of labor-saving devices.
   h. Development will be curtailed. Food webs will be preserved. More areas will be available for recreation, but public access may be limited. It will cost more in taxes to administer the preserved lands.

DESIRED LEARNING OUTCOME: The students should be able to predict the consequences to the environment of both unlimited consumption of resources and energy and more ecologically oriented behavior.

****

DEVELOPMENT: Lesson Cluster 4C-3 Making Choices
Page T-530/S-310 Contradictions (40-45 min.)

PURPOSE: To investigate some unintended and undesirable consequences of human behavior.

ADVANCE PREPARATION: Materials - none.

Language Cards/Key Signs
contradictions
conveniently
traffic jams
privacy
fumes
billboards
behavior
Identification Cards

TEACHING SUGGESTIONS:

1. Have the students read pages 310-311 and answer the questions. Teacher may paraphrase.

2. Discuss the answers to the questions. You might summarize the information on a chart like this one.

Behavior	What People Want to Happen	What People Do Not Want to Happen
driving cars	quick transport	traffic jams

3. Emphasize that the nature of an action changes when thousands or millions of people try to do it all at the same time. For example, washing out dishes from a camping trip in a local stream causes no observable harm. But when a townful of people use the stream for washing. . .

DESIRED LEARNING OUTCOME: The students should be able to trace some of the environmental ills of our society back to reasonable human desires that produced unintended results.

****

APPLICATION: Lesson Cluster 4C-3 Making Choices
Page T-532/S-312 What Is Really Important? (30-40 min.)

PURPOSE: To compare human expectations with the environmental effects of satisfying those expectations.

ADVANCE PREPARATION: Materials - paper and pencils
- crayons or colored pencils

Language Cards/Key Signs
make choices
health
medical care
environment
personal

Identification Cards

TEACHING SUGGESTIONS:

1. Have the students read pages 312-313. Teacher may paraphrase.

2. Emphasize before they begin writing their lists that the list is not just necessarily a list of things, but should include activities they like to do, places they want to visit, and so forth.

3. Have students copy the chart on page 313 on a sheet of paper and give them a crayon or colored pencil.

4. Instruct them to complete the chart and be as honest and thorough as they can.

5. You might want to assign completing the chart as an overnight activity.

6. Discuss the students' charts, their choices, and the effects they will have on the environment. Do not judge or criticize personal wants and goals. However, if students have not accurately or adequately filled in the effects of many people satisfying these wants, point this out and help them to fill in the columns properly.

7. See if the class can agree on a composite list of survival needs. Then see if there is general agreement on a list of highly desirable items that are not needed for bare survival but are very important.

8. Instruct the students to answer the questions on page 313.

DESIRED LEARNING OUTCOME: The students should be able to list their expectations from the environment and state the effects of satisfying those needs and wants.

****

EVALUATION: Lesson Cluster 4C-3 Making Choices
Page T-534/S-314 Making Things Worse or Better (30-35 min.)

PURPOSE: To evaluate the students' performance in relation to the following objectives:

1. Giving examples of human behavior that improves the environment.
2. Giving examples of human behavior that degrades the environment.
3. Distinguishing between human wants and needs.
4. Explaining why the achievement of all human desires is neither possible nor desirable.

TEACHING SUGGESTIONS:

1. Have the students answer the questions on page 314 on a sheet of notebook paper. Teacher may paraphrase.

2. Review the questions thoroughly. If a student responds correctly to most of the questions, you may assume that he or she has demonstrated the objectives for the cluster.

Language Cards/Key Signs
survival
satisfied

****

LEVEL 6

SIGNED VOCABULARY AND LANGUAGE INDEX
FOR
SCIENCE FOR THE HEARING IMPAIRED

Instructions for use of this index with the accompanying signed videotapes are found in the Introduction to the Program. This index should be used as a script when viewing the signed videotapes for the specific SFHI cluster or section of interest.

Each part of the videotape is preceded by an indication of the specific location (level, unit, part, Cluster and Lesson) of the item presented. Each item within a lesson is first presented in American Sign Language (ASL) followed by a Manually Coded English (MCE/SEE) presentation of the same item. When a lesson list is completed the title of the next lesson is given, followed by a presentation of each new lesson item in ASL and MCE.

Teachers should view the videotape in planning for each new cluster (2-5 minutes per cluster). It is also suggested that teachers view and practice the signs presented with their classes following lesson experiences or as a review. The videotape can be used as a visual dictionary when the children have forgotten the sign.

The Signed Vocabulary and Language Videotapes are available for purchase and/or copying by writing

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SCIENCE FOR THE HEARING IMPAIRED

Signed Vocabulary for Level 6

Cluster 1A-1 Producers and Consumers

Lesson	Title and Key Signs
1	Corn Growing Experiment corn seeds plain water water with fertilizer plant in the dark plant in the light mass
2	Food and Other Factors producer consumer population organisms first-order second-order third-order terrarium identify the order of consumer grasshopper What are the grasshoppers doing?
3	VanHelmont's Experiment Jean van Helmont experiment scientist minerals a plant
4	Producer Growth acorn germinate stem roots leaves observatory
5	Consumer Growth pols organism great dane dog
6	The Food Factor cornmeal chick

Cluster 1A-2 What Have We Taken?

Lesson	Title and Key Signs
1	Human Consumers mass
2	My Food Intake estimate intake
3	A Population's Food Intake population organisms
4	Animals and Plants as Food plant animal solid fluid water
5	Water a plant drinking water a plant without water
6	Chicken and Corn whole chicken meat
7	Populations and Food

Cluster 1A-3 Population Growth Rate

Lesson	Title and Key Signs
1	Human Population Growth
2	Population Growth increase decrease stable population
3	Observing Population Growth
4	Is My School Growing?
5	Population-Increase or Decrease?

Lesson	Title and Key Signs
Cluster 1B-1	Successful and Unsuccessful Populations
1	Animals and Plants successful population unsuccessful population
2	The Rat rat population habitat
3	Rat Populations and Food
4	Rat Adaptations adaptation properties reproduce litter
5	Rat Enemies natural enemies
6	The American Chestnut Tree American chestnut tree chestnut blight
7	Crabgrass crabgrass
8	Passenger Pigeons passenger pigeon extinct
9	Some Succeed and Some Don't
Cluster 1B-2	The World of Reptiles
1	Reptile Populations reptiles Age of Reptiles populations dinosaurs snakes turtles alligators extinct
2	Dinosaurs dinosaurs predators

Lesson	Title and Key Signs
2 (cont)	fossil horseshoe crab
3	Turtles reptiles shell horny bills
4	The American Alligator American alligator populations underground burrows adult female alligators natural enemies swamps
5	Wrapping Up Reptiles
Cluster 1B-3	The World of Plants
1	Plant Populations plants dinosaurs populations fossils ginkgo trees ferns fan plants palmettos
2	The Ginkgo extinct stomata polluted air pollution
3	Ferns fern-like plants spores spores capsules habitat thallus fern frond
4	Finding Ferns
5	Plant Population Successes

Lesson	Title and Key Signs
Cluster 1C-1	Fuels
1	Energy for Fuels populations environment matter energy fuels coal wood oil energy giver energy receiver
2	Energy Receivers thermometer fuel systems
3	Energy Givers temperature fuel system
4	The Heat Unit heat heat unit degrees
5	Fueling Up
Cluster 1C-2	Food is Fuel for People
1	Food Supplies Energy fuel energy calories heat energy heat units thermometer calorie
2	Energy Chart mass heat units
3	Energy in My Lunch
4	Heidi's Diet diet Heidi
5	The Fuel Called Food
Cluster 1C-3	Putting it All Together
1	Plants Can Put it All Together carbon dioxide light heat minerals water producers environment
2	Food for Consumers consumers body mass first-order consumer second-order consumer third-order consumer
3	The Other Ninety Percent mass waste products decomposers
4	Population Interact populations communities compete for space compete for food
5	Use of the Environment
Cluster 2A-1	What is a Model?
1	Cars of the Future model scale physical model drawing model idea model clay
2	Ideas as Models path predict mirror ball light path

Lesson Title and Key Signs

Cluster 2A-1 (cont)

2 (cont) ball path
noun
flashlight

3 The Hidden You
system
interaction

4 Designing a Chair
design
chair

5 The World of Models

Cluster 2A-2 Ideal Models

1 The Ideal Model
practical
properties
bicycle
product
ideal model

2 Properties of the Ideal Flying Machines
airplane
weight
angle
wing size
distance

3 Making Ideal Models
hamburger
painting
potted plant
pencil

4 The Ideal Model and Time
Leonardo da Vinci
William Henson
1800
1900
1950
properties

5 The Ideal in Models

Cluster 2A-3 Scale Models

1 Large and Small Scale Models

Lesson Title and Key Signs

1(cont) large scale models
small scale model:
scale model
scale (matched to size)
scale (balance)

2 Large and Small to Scale
large object
small object

3 Drawing to Scale
grid
scale drawing

4 Making a Scale Model of a Room
room plan
blueprint
house plan
scale model

5 Using Scale Models
advantage

integrated circuit
shopping center
space station

6 Inferring Size From Scale Models

Cluster 2A-4 Models of Earth and Sky

1 Spheres
round
sphere
shape
spherical
globe
North Pole
South Pole
ball
plate

2 Sphere Throwing
circle
largest
smallest

3 Spheres and Maps
map
flat map
stretched
torn map
globe

Lesson Title and Key Signs

Cluster 2A-4 (cont)

4 Solar System Model
planet
Mercury
Venus
Earth
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto
meter
centimeter
scale
solar system

5 Space Models

Cluster 2B-1 Models of Interaction

1 Exploring Evidence of Interaction
system
evidence of interaction

2 Hidden Interactions
food dye
red
yellow
green
blue

3 A Model of Interaction
coins
property
balls
fruits

4 A Scoot System
hidden interaction
draw the system
scoot system
hidden
cover (of box)
shoebox

5 Make Your Own Scoot System
rectangle
slant
cardboard box
marble

Lesson Title and Key Signs

6 Selecting Models of Systems

Cluster 2B-2 Models of Past and Present

1 Dinosaurs
inference
paleontologist
fossil
fossilized bones
skeleton
model

2 Using Clues
system
inference
interact

3 Clues From the Past
archeologist
carving
pyramid
tools

4 Models of the Past
one rope
a branding iron
a wagon wheel
some bones
auto tire
inference
evidence
observations
model
objects

5 Time Capsules
a time capsule
a baseball bat
alien
a long playing record
a scarf

6 Models of the Present

Cluster 2B-3 Simulation Models

1 Learning From Models and Games as Simulation Models
simulation
simulation model
board game

Lesson Title and Key Signs

Cluster 2B-3 (cont)

2 Litterbug
penalty card
reward card
litterbug game
players
play money
anti-littering
environment
real-life
littering

3 A Simulation Model
magazine
cone
test

4 Models Everywhere
checkers
pieces
stimulate

Cluster 2C-1 Predicting From Models

1 Weather Symbols
weather
weather map
weather symbol
predict
model

2 Recording Your Own Weather
record
temperature
wind speed
wind direction
prediction
cloud cover
actual weather
weather chart
West
East
South
North
Southwest
Northeast
Northwest
Southeast

Lesson Title and Key Signs

3 Weather Map Models
front
cold front
warm front
Montreal
Albany
New York
Boston

4 Your Weather Predictions
weather chart
weather prediction
temperature
direction
warmer
cooler
wind
cloud cover
record

5 Predicting From Weather Map Models
city
cloudy
rain
wind speed

Cluster 2C-2 Models of Human Communication

1 Reaction Time
internal communication system
message
catch the card
a communication system model
prediction
model
reaction time

2 Measuring Reaction Time
reaction timer
one-hundreth of a second
test
trial
30 cm ruler
graph paper

Lesson **Title and Key Signs**

Cluster 2C-2 (cont)

3 Left or Right?
chart
which hand is faster

4 Right and Left Brain
class average
communicate
infer
brain
Sharon's results
Coleman's results
internal communication system
model
left brain
right brain

5 A Final Look at Reaction Time

Cluster 2C-3 Models of Earthquakes and Volcanoes

1 A Model of the Earth
fault
erupt
earthquake
volcanoes

2 An Earthquake Prediction Model
earth-quake prediction table
longitude
latitude
Is there an earthquake pattern?
What must the earth's crust be like?
locating earthquakes map
earth's crust
pattern

3 Volcanoes and Earthquakes

making a model
connecting
volcanoes and earthquakes
volcano
earthquake

4 Detecting Earthquakes
million
intensity
earthquake magnitude

Lesson **Title and Key Signs**

4 (cont) seismograph
Richter Scale
Modified Mercalli Scale

5 Predicting With Models
fault
earthquake
volcano
predict

Cluster 3A-1 Inferring From Models

1 A Secret Object
object
system
interaction
inference
infer
model
properties
size and shape

2 What's Inside?
Scoot System
cardboard
marble
shoe box

3 Circuit Puzzle
interact
aluminum foil
wires
batteries
circuit
puzzle
bulb
model
combination
connection
what happens?
draw a model
aluminum foil
battery
circuit puzzle

4 Puzzles to Solve

Lesson	Title and Key Signs
Cluster 3A-2	Models for Mixing Systems
1	What is a Mixture?
	this is a mixture
	what will happen?
	what will the properties be?
	property
	mixture
	predict
	combination
	materials
	mixing system
	powder
	drink powder
2	The Push Model
	what do you observe?
	push model
	model
	mixing
	observe
	materials
	liquid food coloring
	support
	evidence
	cup
3	Predicting With the Push Model
	predicting
	food coloring
	height
	surface
	prediction
4	Hot and Cold
	push model
	what do you think would happen?
	what do you observe?
	liquid
	temperature
	difference
	evidence
	fair
	immediately
	compare
	heated food coloring
	cool food coloring
5	Large and Small
	what do you predict?
	dissolve
	candy
	crush
	fair
	solid
	observation
	whole candy
	crushed candy
6	The Shake Model
	shake model
	what happens?
	materials
	mix
	label
	salt
	container
	medicine dropper
	different
	interpret
	results
	salt
7	More Models
	sticky model
	small particle model
	successful
	mixing model
	developed
	unstick
	movement
	material
	rate
Cluster 3A-3	Models of Mixing and Unmixing
1	How Do Solids Mix With Liquids?
	what happens?
	small particle model
	push model
	shake model
	sticky model
	models
	mixing
	interaction
	coffee stirrer

Lesson Title and Key Signs

Cluster 3A-3 (cont)

1 (cont) estimate
observations
evidence
solid
liquid
fruit drink powder

2 Slow Motion Mixing
model
system
interaction
gelatin
food coloring
observation
plastic wrap
surface
evidence
predict
eye dropper

3 Unmixing Mixtures
mixture
unmix
liquid
material
common
paper towel
cone
ink

4 Mixing Paint
what model is best here?
pallette
interaction
tube
mixing
paint
concrete
artist
paint

5 The Amazing Cotton Ball
what interacts with the water?
cotton ball
alcohol
evidence
observe
effect
fair
experiment

Lesson Title and Key Signs

Cluster 3B-1 What is the Small Particle Model?

1 How Did the Solid Get One?
watch closely
small particle model
which are bigger.
What do you observe?
interaction
magnifier
matter
particle
teabag

2 Becoming A Mixing Model
mixing model
interaction
model
paper wad

3 Space in Matter

particle
alcohol
air bubble
investigation
medicine dropper
food coloring
alcohol

4 What Will Mix Faster?
which mixes faster
predict

observation

5 Temperature and Dissolving
what happens?
dissolve
predict
fair test
evidence

6 Which is in Hot Water?

Cluster 3B-2 Heat Affects Matter

1 Heating and Cooling a Liquid
small particle model
what is the temperature?

Lesson	Title and Key Signs
Cluster 3B-2 (cont)	
1 (cont)	what happens? thermometer
2	Warming Air what happens as the air becomes warm? matter evidence investigation particle
3	Bridges and Tracks expansion contraction expansion joint
4	Expansion and Contraction
Cluster 3B-3	Solids, Liquids, and Gases
1	Properties of Gases what happens? is your bag half full? is there any part of the bag that has no air in it? small particle model how do you know you have something in the bag? how much is in your bag? is your bag full? properties evaporate pollution tire pump small plastic bag perfume
2	Melt Ice Race small particle model
3	Liquid to Gas to Liquid changes of phase gas solid liquid water vapor
4	Evaporation and Temperature energy giver energy receiver evaporation
5	How Does Popcorn Pop? popcorn popper cooking oil
Cluster 3B-4	Surface Properties
1	Heating Water small particle model property diameter prediction particle waxed paper medicine droppers soapy water plain water
2	Water Surface and Paper Clips magnifier
3	Did Your Finger Get Wet? talcum powder
4	Measuring the Grabbiness of Water surface tension grabbiness force measurer
5	Know the Surface water strider
Cluster 3C-1	Liquids and Gases Flow
1	Mixing Hot and Cold Liquids small particle model prediction particle medicine dropper food coloring vial

Lesson	Title and Key Signs
Cluster 3C-1 (cont)	
2	Convection Currents convection current heat energy aluminum foil
3	Liquid Layers in Soda Straws
4	Evaporation and Condensation evaporation condensation energy receiver energy giver phases matter
5	The Water Cycle where does rain come from? evaporate what are the sources of water in the air? what is the heat source for the evaporation of water? simulation model system
6	Rain altitude
7	Motion of Matter water cycle
Cluster 3C-2	Gases Interaction With Liquids
1	Gases Mixing With Liquids small particle model interactions carbon dioxide indicator chemical solution colorless soda water seltzer BTB
1 (cont)	soda water seltzer tablet plastic straw
2	Your Experiences With Soda Water
3	BTB and Carbon Dioxide carbon dioxide BTB solution interact fair test
4	Limewater and Carbon Dioxide indicator lime water interaction
5	What Can Get Out of a Plastic Bag? airtight water tight plastic bag
6	Gas Interactions infer
Cluster 3C-3	Scientists and Models
1	Aristotle and Galileo thermometer
2	Testing Aristotles's Model of Falling Objects Aristotle's model fair test
3	Predicting Earthquakes earthquake prediction San Andreas fault seismograph computer
4	Life From Life Van Helmont Redi model larvae
5	Testing Models mosquito malaria falling objects

Lesson Title and Key Signs

Cluster 3C-3 (cont)

5 (cont) model
astronaut
Apollo 15
moon
earth
disease
microscope
organism

Cluster 4A-1 Ecosystems

1 What is an Ecosystem?
ecosystem
system
environment
mental models
interact

2 Making Model Ecosystems
insert populations
organisms
ants
grasshoppers
beetles
soil
wood
microscope
microorganisms
factors
populations
terrariums

3 Decomposers
decomposers
rotting leaves
rotting wood
mold
fungi
decomposing terrariums

4 Ecosystems in Space
outer space
spaceship
closed ecosystem
recycle
Earth
consumed
wastes

Lesson Title and Key Signs

5 Making a Closed Ecosystem
aquatic system
crickets
isopods
guppies

6 A Nearby Ecosystem

Cluster 4A-2 Interactions in Ecosystems

1 Everything Connects
interactions
connects
forest ecosystem
air
soil
worms
tree
bird
robin
energy transfer

2 Matter Cycles Through an Ecosystem
cycles
transferred
snail
carbon dioxide
oxygen
minerals

3 Where Do You Get All Your Energy?
solar energy
heat
sunlight
fuels
coal
oil
natural gas
firewood

4 Other Interactions
interactions
pollen
nectar
reproduce
fungus infections
cleaners

Lesson Title and Key Signs

Cluster 4A-2 (cont)

5 You Cannot Do Just One Thing
- Arizona
- produce
- first-order consumers
- deer
- mice
- rabbits
- chipmunks
- preyed on
- second-order consumers
- lions
- coyotes
- populations

6 Is a Zoo An Ecosystem?

Cluster 4A-3 People Change the Face of the Earth

1 Organisms Change Ecosystems
- organisms
- ecosystems
- beavers
- dams
- meadows
- ponds
- marshes
- ducks
- fish
- North America
- Egypt

2 Some Effects of Farming
- farming
- prehistoric people
- "face of the earth"
- natural ecosystems
- woods
- grasslands
- landscapes
- fertilizers

3 Burning Down the Woods
- burn
- forest fire
- primitive tribes
- meadow
- pasture
- prairies

Lesson Title and Key Signs

3 (cont)
- graze
- bulldozers

4 The Effects of Livestock
- livestock
- hunt
- raising herds of animals
- fenced-in pastures
- sheep
- grass
- overgrazing

5 Overfishing
- New England
- Canada
- fishermen
- bluefin tuna
- Portuguese
- sperm whales
- sea turtles
- overfishing
- prey
- endangered species

6 Environmental Impact Studies
- environmental impact study
- Aswan Dam
- Nile River
- mud
- snails
- farmlands
- minerals
- predict
- ocean
- hotel

7 Effects of People

Cluster 4B-1 Conserving Resources

1 We Cannot Make or Destroy Matter
- to make
- create
- destroy
- matter
- copper ore
- copper metal
- metals
- conservation

Lesson	Title and Key Signs
Cluster 4-B1 (cont)	
2	Kinds of Resources resources recycled polluted renewable non-renewable
3	Recycling Water recycling water cycle rain water
4	Why Conserve Resources? conserve oil copper plastic create ecosystems
5	How Can We Conserve? electric non-returnable conservation
6	Managing With Less managing commuters
7	Resources
Cluster 4B-2	Everything Goes Someplace
1	Nothing is Ever Really Lost matter destroyed disposing waste matter dumps trash heaps pollution
2	Water Pollution water pollution sewage poisonous decomposers oxygen

Lesson	Title and Key Signs
3	Air Pollution air pollution dust pollen car exhaust Dust-E-Cubes
4	Managing Town Dumps garbage landscape trash sanitary landfill compost pile
5	What Should We Do About Throwaways throwaways drink containers ballpoint pens portable radios
6	Trash Cans
Cluster 4B-3	Our Part in the Pollution Problem
1	We All Cause Pollution pollution waste environment transportation
2	Classroom Waste
3	Pollution Can Be Reduced reduced devices smokestack soot personal
4	We Are All Affected by Pollution affects health breathe coughing sneezing lung disease poisonous

Lesson Title and Key Signs

Cluster 4B-3 (cont)

5 Watch Out For Yourself
polluted
somewhat polluted
badly polluted

6 Clean and Dirty

Cluster 4C-1 Using Electricity

1 Electricity in the Classroom
electricity
energy
convenient
transform
electric energy
watt-hours
60 watt bulb

2 Electric Use at Home

3 Reading Your Meter
meter

electric meter
kilowatt hours
kilowatt
watt
dials
metered amount

4 Conserving Electricity
conserving
aluminum industry

5 Using and Saving Watts

Cluster 4C-2 Energy Sources and Problems

1 You Use Energy
electric energy
coal furnaces
gas furnaces
gas stoves
oil hot water heaters
gas
energy source
personal energy use
observed energy use

Lesson Title and Key Signs

2 Fuel Consumption
fuel consumption
odometers
gallon per mile
liters per kilometer

3 Big Energy Supplies
energy suppliers
oil
coal
geothermal
solar
nuclear
generators
transformed
ecosystems

4 Environmental Costs
environmental costs
coal mining
coal piles
strip mines
black lung disease
polluting

5 More Energy With Less Damage
damage
sunlight
wind
solar heaters
windmill
wind energy
convenience
muscle power
solar meters

6 Making A Model Solar Heater
solar heater
styrofoam box
thermometer
dark plastic
maze
air flow

7 Supplies and Costs

Lesson	**Title and Key Signs**
Cluster 4C-3	**Making Choices**
1	**Predicting the Future** predict the future predictors conserve resources natural ecosystems pollution recycling
2	**Contradictions** contradictions conveniently traffic jams privacy fumes bill boards behavior
3	**What is Really Important?** make choices health medical care environment personal
4	**Making Things Worse or Better** survival satisfied

[redacted]

Teachers Guide for Level 7

SCIENCE

Adapted

For the Hearing Impaired

Dennis W. Sunal

Cynthia Szymanski Sunal

SFHI

SCIENCE

for

the HEARING IMPAIRED

Level 7

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Introduction

Many teachers and administrators have long been concerned with the lack of appropriate science materials and aids for teaching hearing impaired youth. This disadvantage is most critical for the middle childhood aged student in special hearing impaired classrooms or joined with their hearing peers in regular classrooms. Many students have been denied adequate access to science as a discipline because it was too difficult or because ways to present it to hearing impaired youth beyond traditional methods could not be envisioned.

To meet this concern the Science for the Hearing Impaired (SFHI) project was proposed. Its primary aim was to make available, for the first time, a complete sequenced science program for the hearing impaired which would foster the development of abilities and attitudes in the sciences in hearing impaired youths at this critical age.

This volume represents two years of planning, development, classroom testing, evaluating, and rewriting to produce a science program effective for hearing impaired middle childhood youths. To date, the success of these materials with teachers and students has been assuring. The SFHI introductory guide which describes the program materials, teaching strategies and use of program components, along with the individual program teacher's guides presents all essential information needed for maximizing learning for this special population of youth.

Level 7 Unit 1 Looking at Life

Chapter 1 Thinking About the World

Observing the World

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
-	1.0*	Introduction	35-40 min.
T-20	1.1	What is Observation?	45-50 min.
T-20	1.2	Your Eyes Can Fool You	45-50 min.
NOTE: *This section has been added and does not appear in the text.			

SECTION: 1.0 Observing the World
Introduction (35-40 min.)

PURPOSE: To introduce the students to optical illusions.

ADVANCE PREPARATION: Materials -a variety of optical illusions different from 1.2
-materials for several magic tricks

Language Cards/Key Signs
an optical illusion
a magician
a pattern
to trust
to gaze

Identification Cards
an optical illusion

TEACHING SUGGESTIONS:

1. Begin the class by showing the students some magic tricks (optical illusions). Discuss their reactions to the tricks. Ask them how they were done. Tell them that magic tricks are illusions.

2. Pass out the optical illusions. Have the students look at each one carefully. When all of the students have looked at them, discuss each illusion. Ask what they see, and discuss their reactions to the illusions. Tell the students that these are called optical illusions. Show the language Card. Explain what the term means.

3. Have the students read the Introduction to Chapter 1. To start with, the students should read only the first two paragraphs. Discuss what they have read, relating it to the previous events.

4. Have students take turns reading the directions for the next experiment. Hold up the language card and explain any new vocabulary words. Have the students perform the experiment. Discuss what they saw.

5. Have the students read the last paragraph on page 3. Discuss it with them.

6. Review all of the new terms for this lesson. Ask the students if they can trust their sense of sight.

SECTION: 1.1 Observing the World
Page T-20/S-4 What is Observation? (45-50 min.)

PREREQUISITES: To be able to list the five senses.

ADVANCE PREPARATION:

Background Information: Observation is defined as noticing or paying close attention to surroundings through all the senses, not just the eyes. At any time, you pay attention to only a very small amount of the information coming to your brain from your senses. Like all skills, observation skills can be improved with practice.

Language Cards/Key Signs
the five senses
to observe
an observation
to notice
to witness
a sense

Materials -worksheet with questions as on page 5 (You may wish to change some of these questions. They should be about school-related topics.)

TEACHING SUGGESTIONS:

1. Demonstration. Do this exercise before beginning the section. It is sure to generate involvement and enthusiasm. Stage an "incident" in class by arranging to have someone burst into the room unannounced, grab an object you have left on a table, and run out of the room. After the dust settles, tell the class that they have been "eyewitnesses" to an incident that you have arranged for their benefit. You can then play the role of police officer or detective. Ask the students to describe as much as they can about the incident. What did the "thief" look like? What clothes was the "thief" wearing? What was the object stolen and what did it look like?
   This exercise may result in heated discussion since "eyewitnesses" who saw the same thing will differ greatly in what they perceive. If possible, have your actor return to the room after some discussion so the students can check their observations.

2. Give the students the worksheet. Have them fill it out without looking at anything but the paper. Discuss their answers.

3. Have the students read through the text, beginning with the section on Sherlock Holmes. Then have them read through and discuss the information on observation and the five senses. Have them do the activity on page 5 with the picture. Discuss the variety of answers.

4. Have them read the first paragraph on page 6.

5. Review all vocabulary used in the lesson.

****

SECTION: 1.2 Observing the World
Page T-20/S-6 Your Eyes Can Fool You (45-50 min.)

PREREQUISITES: To accurately measure lines.

ADVANCE PREPARATION:

Background Information: To be a good observer you have to be aware that your senses do not always provide you with an exact reproduction of your environment. Examples are given in this section to show that what you perceive is a result of the interaction of your senses and your brain.

Language Cards/Key Signs	
an optical illusion	
to measure	to focus
to overlap	

Materials -rulers
-copy the figures on page 7 without the questions

TEACHING SUGGESTIONS:

1. Pass out the worksheet of the illusions. Have the students look at each illusion. Ask them what they are seeing. Ask them how they could prove that they are correct. Encourage them to develop the idea of measurement.

2. Since this exercise requires measurement, if the students need review, they can go to Appendix A, before the actual measurement is done.

3. Have the students read page 6 and discuss the information. Review the vocabulary of an optical illusion, and the senses.

4. Have the students look at Figure 1.3. If they have not done the actual measuring, have them do it now. Then have them discuss the answers to the questions on the Figure.

5. Have the students read aloud the directions for the next experiment.(last paragraph, first column, page 8). Then have them perform the experiment. Check their accuracy in placement of their fingers. Make sure that all students see the illusion. Explain to the students why they see this (first and second paragraph, second column, page 8).

6. Go on to discuss Figures 1-5, 106, and 1-7. Explain the ideas stated in the text. The students need not read this part. With each figure, let the students look at the figures and discuss it before you tell them what is happening. See if the students can make their own conclusions about the illusions.

7. To conclude the lesson, discuss the highlights. Ask the students what observation is, and how we can see things incorrectly.

8. Have the students answer the Checkpoints on a piece of paper. Discuss their answers. Be sure that each student comprehends the concepts of these first few sections.

9. Answers to Checkpoints (page 11):

    1. Sight, hearing, taste, touch, and smell. Answers will vary.
    2. In an optical illusion, two lines can look as if they are different lengths even though measurements show them to be the same. A picture that seems to show "hills" viewed from one direction shows "valleys" when viewed from the opposite direction. Pictures such as those in Figure 1.7 show that you can see one picture in two ways, but you can see it only one way at a time.

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Level 7 Unit 1 Looking at Life

Chapter 1 Thinking About the World

The Effect of Past Experience

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-21	1.3	Experience Influences What You See	45-50 min.
T-21	1.4	Your Memory Stores Information	35-40 min.
T-23	1.5	You Make Inferences Based on Your Experience	40-45 min.

SECTION: 1.3 The Effect of Past Experiences
Page T-21/S-11 Experience Influences What You See (45-50 min.)

ADVANCE PREPARATION: Materials - Have sentences/poem in French, German, Spanish on a transparency or large sheet of paper. Also have one poem in English.

Language Cards/Key Signs
to recognize a pattern
shapes
past experience

Identification Cards

TEACHING SUGGESTIONS:

1. The selection of Russian shown in Figure 1-8 is from a poem by Aleksandr Sergeyevich Pushkin entitled Autumn. A translation follows.

   Autumn
   October has arrived - already the grove is shaking
   The last leaves from its naked branches.
   Autumn has breathed its chilly breath, the road is
     freezing,
   The water still runs babbling in the mill stream,
   But on the pond the ice has already hardened; my
     neighbor hurries
   Into the distant fields on his hunt,
   And the winter crops suffer from the frenzied sport;
   And the barking of the dogs stirs the sleeping forest.

2. Show the students the various poems in different languages. Ask them to read them to you. When they cannot, ask them why they cannot.

3. Discuss the poem on page 11. Again ask why they cannot read this. Explain that past experience has a lot to do with what we can understand. Use the language cards when you discuss the terms.

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4. Have the students read through the information on page 11. If the students are interested, read them the translation of the poem.

5. Discuss figures 9A and 9B, asking the students the questions from page 12. Do the same with figures 10 and 11. Discuss their answers to the questions.

****

SECTION: 1.4 The Effect of Past Experiences
Page T-21/S-12 Your Memory Stores Information (35-40 min.)

ADVANCE PREPARATION: Materials - copy chart from figure 1-12 on transparency and ditto
- choose letters to be used in experiment
- 2 copies for each student

Language Cards/Key Signs
to remember
memory
long term memory
information

Identification Cards

Background information - See teachers manual. Memory has two separate components - storage and recall. You may have many memories stored that you cannot recall. Almost everyone has at some time tried to remember something and had it "on the tip of my tongue." Hours or even days after you have given up trying to remember something, it will suddenly flash into your mind.

TEACHING SUGGESTIONS:

1. Begin the lesson by having the students read the experiment on page 15. (Starting under the line and continuing to page 16.) Read a section and then do the experiment, then go on to the next section.

2. Distribute paper and pencils. Review the instructions for the first part of the activity with the class. Read a three-letter sequence aloud. Avoid sequences like XYZ or FBI that would be easy to remember. Students should sit quietly for 30 seconds and then write down the three letters. Record on the chalkboard the total number of students who correctly remember the sequence. The number of correct responses should be very high.

3. Choose a different three-letter sequence for the next trial. After you say the letters, students should count aloud as instructed in the text during the 30-second waiting period. This is done to preoccupy their minds so they cannot practice the three-letter sequence. After 30 second have elapsed, ask students to write down the three letters. Again, record the number of correct responses. This activity demonstrates that for information to get into the short-term memory, it must be practiced or repeated in the brain.

4. For the second part of the activity, pass out the ditto with figures 1-12. Read aloud this list of 12 random letters: A C W Y A S U S O S V T. Read at a rate of letter per second. When you are finished, students should write as many letters as they can remember in the chart. It is important that they try to put something in every space in the chart whether it is correct or not. Now repeat the letters. By a show of hands, determine how many students remembered each letter correctly. Record the numbers on the chart you drew on the chalkboard. At the completion of this experiment, collect all student papers, and remove the chart.

5. When the experiment has been completed, go back to the beginning of this section. Have the students read the information and discuss the questions.

6. Write the terms short term memory and long term memory on the board. Ask the students if they can define them. Discuss their meaning in relation to the experiments done. Tell the students that at the end of the class, you will be testing their memory again.

7. At the end of the class, pass out another copy of figure 1-12. Ask the students to again fill in the letters as they did before. Compare the results to the other term memory experiment. Discuss the results, and the time factors involved.

* * *

SECTION: 1.5 The Effect of Past Experience
Page T-23/S-16 You Make Inferences Based on Your Experience (40-45 min.)

PREQUISITES: To make inferences from given information.

ADVANCE PREPARATION: Materials - Create a story similar to the one on page 16, using an incident in your school.
- Develop inference questions about the story.

Language Cards/Key Signs
to infer
an inference
experience

Identification Cards

TEACHING SUGGESTIONS:

1. Read your story to the class, one time. Then ask the questions which you have developed. Discuss the process which the students are going through (inferring).

2. Include in your discussion, the fact that their inferences may not be correct. Add additional information to the story to make them incorrect. Use the term an inference, and use the language cards as you discuss this and other terms.

3. Have the students read the beginning of section 1-5. Discuss the problem with the glass pitcher.

4. Go on to discuss the story about Anthony and Sally. Have one student read the story to the class. Then discuss the information contianed in the next four paragraphs.

5. Read the last paragraph to the students. Explain each point, and emphasize that they are observing, and inferring, and that they can change these inferences.

6. Have the students read the Highlights section themselves. Then discuss each point.

7. Have the students write their answers to the Checkpoints on paper. Collect their papers for grading and discuss their answers.

8. The answers to these questions are listed here:
   1. Figure 1-10 (c) would probably look like black marks on a white background.
   2. Remembering a phone number long enough to use it. Accept other reasonable answers.
   3. Sally is probably three to five years old. She speaks in full sentences but she makes grammatical errors that would be expected of a preschool child.
   4. You might infer that the cat ate the mouse. The statement says that the cat is hungry, and experience tells you that cats catch and eat mice.

* * *

Thinking Scientifically

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-23	1.6	Science Starts with Observation	40-45 min.
T-23	1.7	Forming a Hypothesis is Next	40-45 min.
T-23	1.8	Hypotheses Can Be Tested by Controlled Experiments	45-50 min.

SECTION: 1.6 Thinking Scientifically
Page T-23/S-18 Science Starts with Observation (40-45 min.)

ADVANCE PREPARATION: Materials
- at least 30 each of three different colors of poker chips or squares of colored paper
- pictures of scientific tools

Language Cards/Key Signs
a scientist
to test inferences
problem solving
to record
tools
a logical way

TEACHING SUGGESTIONS:

1. Begin the lesson by telling the students that you are going to be two different people. Take the poker chips and tell them that the problem is to figure out how many different combinations of these chips can be made. Tell them this is an experiment in problem solving. Use the language card.

2. The first time, solve the porblem in a 'hit or miss' fashion, not in any logical sequence. The second time, do it in a logical manner. When you have completed the two experiments, ask the students which one was performed by a 'scientist' using scientific thinking. Discuss their answers.

3. Because this section has so much information, read the text to the students and discuss each concept and vocabulary word as it occurs.

4. Before discussing Figure 15, ask the students to list other tools that scientists use. Make a list on the board. Show the pictures which you have collected of different tools. Then discuss the more sophisticated tools in the Figure on page 20

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SECTION: 1.7 Thinking Scientifically
Page T-23/S-19 Forming a Hypothesis is Next (40-45 min.)

PREREQUISITES: The ability to formulate and use if...then statements.

ADVANCE PREPARATION: Materials -none

Language Cards/Key Signs
a hypothesis
a prediction
an experiment
an observation

TEACHING SUGGESTIONS:

1. Begin the lesson by explaining the first paragraph to the students. Then read the example about the school bus. If this example is inappropriate for your students, change it to something that is relevant to their school situation.

2. Then write the following on the board:

   Thinking Scientifically
   Problem Solving
   -Observation
   -Making a Hypothesis
   -Prediction
   -Experimentation
   -Recording Results
   -Proving or disproving hypothesis

3. Using an example of an experiment relevant to your students, talk through this chart, explaining the concepts as you go through the lists.* Have students give real examples of if-then happenings. (e.g. If it is cloudy - then it may rain.)

4. As a review the students could read through the text and discuss the information again.

5. At the end of the lesson, have a few students explain the sequence listed on the board to the rest of the class.

*When discussing the prediction section, have the students use the if...then format, for stating their predictions. If the students have difficulty with this, have some practice with if...then statements before the lesson begins, as is stated in the prerequisites.

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SECTION: 1.8 Thinking Scientifically
Page T-23/S-21 Hypotheses Can Be Tested By Controlled Experiments (45-50 mi
(45-50 min.)

ADVANCE PREPARATION: Materials -four plants of the same size and kind
-the chart from previous lesson on paper or transparency

Language Cards/Key Signs
the control group
the experimental group
to predict
an experiment

TEACHING SUGGESTIONS:

1. Display the plants in the front of the classroom. Ask the students to think of

some hypothesis about the plants and plant growth. Write the different ideas on the board. Have the students choose one hypothesis.

2. Display the chart of scientific thinking. Have the students discuss making observations of plants and the hypotheses that they have made.

3. Have the students discuss possible ways of setting up the experiment. Have your questions lead them to the conclusion that they need two groups in the experiment. When they come up with this idea, tell them the names for the groups. Add them to the chart after the word Experimentation.

4. Discuss what would happen if there were no control group in the experiment.

5. Have the students read the guidelines on page 22, second column. Discuss each guideline in relation to their experiment. If some of the students are interested, have them do the experiment after class and record the results. This could be discussed in the class at the completion of the experiment. For additional help and ideas for student activities, see the Challenge Activities Program in Science level 6. Some sample activities which might be initiated at this time (or after 6 below) by different students are:
   page T-36 "Mr. Green House" - to determine factors that promote growth
   page T-40 "Bubble Fun" - demonstrate and recognize factors affecting cohesions of molecules
   page T-46 "Come Fly With Me" - discover some factors in successful airplane flight

6. Discuss the problem of the Loch Ness monster. Have the students read the information about the monster, and discuss the various hypotheses.

7. At the completion of the lesson, discuss the points in the Highlights section. Then have the students write the answers for the Checkpoints. Collect their papers and discuss their answers.

8. Do the Skullduggery section as a group. Modify the language when necessary.

9. Read through the What's Next? section with the students. Discuss the concept of living and non-living things. Have the students make lists of non-living and living things on a sheet of paper. Use these lists when beginning the next chapter.

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Level 7 Unit 1 Looking at Life

Chapter 2 Recognizing Life

Life Activities

SECTION OUTLINE

Page	Section Number	Lesson Title	Teaching Time
T-26	2.1	What Is Life?	35-40 min.
T-26	2.2	Respiration Releases	40-45 min.
T-26	2.3	Energy From Food Some Organisms Make	40-45 min.
T-28	2.5	Organisms Exchange Gases With Each Other	40-45 min. (3 days)

NOTE: Section 2.4 has been omitted.

SECTION: 2.1 Life Activities
Page T-26/S-28 What Is Life? (35-40 min.)

PREREQUISITES: The ability to distinguish living from non-living objects, and to give characteristics of each class.

ADVANCE PREPARATION: Materials - Have several living and non-living objects to display in the class.

Language Cards/Key Signs
a cell
an organism
movement
growth
reaction
reproduction
life activities
energy
environment
a structure

Identification Cards
(Labels for the objects used in the lesson.)

TEACHING SUGGESTIONS:

1. Do as a demonstration, life characteristics with a problem.

2. Begin the lesson by placing the objects which you have collected, on a table in front of the class. Have the students name the objects. Label them accordingly.

3. Ask the students which objects are living and which are non-living. Write these two terms on the board.

4. Have the students give their responses for thinking that an object is living or non-living.

5. Have the students read pages 28-29 themselves. When they have completed their reading, ask them to explain what an organism is. Then ask them to list the five life activities. Write these on the board. Ask several students to explain the terms.

6. Have the students look at Figure 2-1 and answer the question on page 29.

7. Read the text on page 30 to the students. Explain the concepts as you read through the material. Place special emphasis on the term environment, having the students explain it as the term occurs in the text.

8. Read the paragraphs about cells to the class. Ask the students to define the term cell and discuss Figure 2-2 in terms of this definition. Tell the students that later in the chapter, they will be learning more about cells.

****

SECTION: 2.2 Life Activities
Page T-26/S-31 Respiration Releases (40-45 min.)

PREREQUISITES: Familiarity with the terms oxygen, carbon dioxide, and with the functions of the respiratory system of the human.

ADVANCE PREPARATION: Materials
- beakers, 250 mL or small jars (8oz.)
- limewater, 1 bottle (purchased or homemade - see Section Notes)
- 3 aquarium air pumps
- pieces of rubber tubing each 30 cm long (1 ft)
- straws
- 1 watch or clock

Order limewater from a science supply house or prepare your own according to these directions. Fill a large jar (that has a lid) with distilled water. Add more calcium hydroxide or calcium oxide than can dissolve in the water. Close the jar tightly and shake well for a few minutes. Let it stand overnight. The next day, filter the liquid. Store in a tightly sealed container. The liquid should be clear. If it becomes cloudy, refilter it.

Language Cards/Key Signs
bacteria
yeast
respiration
oxygen
carbon dioxide
to combine
to release
fermentation
gasohol

Identification Cards
limewater
a beaker
an aquarium air pump
a rubber tube

TEACHING SUGGESTIONS:

1. (This lesson will begin with the experiment on page 32.) To review, ask the students about their respiratory system. Discuss the exchange of oxygen and carbon dioxide. Ask them if they can prove that their exhaled air contains carbon dioxide.

2. Display the materials for the experiment. Ask the students to label the materials, helping them with new objects.

3. Without having the students read in their books, pass out the materials, to pairs of students. Explain what they are to do and explain that they must observe what happens to the limewater. After they have completed the experiment, discuss the results. Ask the students if they know why the limewater became cloudy.

4. Have the students read the information on page 32 (second column). Again discuss this information.

LIFE CHARACTERISTICS WITH A PROTOZOAN

Materials and Equipment

Overhead Projector
Petri Dish
Water
Dupont Duco Cement

To The Teacher

The mercury "ameoba" has been used for many years as a vehicle for exploring life characteristics. Mercury is highly toxic and this inquiry can be carried out just as well with a substitute. The substitute is Dupont Duco Cement (similar cements will not work as well). This cement, when mixed with water, will move about rapidly.

Procedure: Place a petri dish on an overhead projector and fill about half full with water. Turn on the projector. Introduce about one drop of Dupont Duco Cement onto the water in such a way that students do not really know what is being put into the water. The drop will project well on the screen and resembles a moving protozoan.

To the Student

Tell the students that you have just put some material into the water. Have students list some of the life characteristics that they can observe. What are some of the life characteristics that they cannot observe? Is this a living organism? Why?

To the Teacher

This inquiry notes an excellent place to begin a biology course. Students realize early that the living state is complex and cannot be easily defined.

Alternative or additional demonstration can be made with

1) Brine shrimp in salt water
   Petri dish
   Algae

5. Explain to the students that they have gathered information about their body and how it fits into the concept of respiration. Write this term on the board.

6. Read through the text with the students, having them read a paragraph and then discussing the information as a group. Have several students explain Figure 2-3. Have them explain the exchange in terms of their body.

7. Read through the information on page 32 (second column, bottom) with the students. Explain each of the ideas here. These are difficult and may be hard to understand.

8. Conclude the lesson by having several students explain respiration and how human systems function with this process.

****

SECTION: 2.3 Life Activities
Page T-26/S-34 Some Organisms Make Their Own Food (40-45 min.)

ADVANCE PREPARATION: Materials
- Elodea sprigs
- rulers
- large test tubes
- aquarium water
- sodium bicarbonate, 1 box (optional)
- rubber stoppers (to fit test beakers, 250 mL)
- 1-2 large boxes with lids (or empty drawers) in which beakers will fit
- test-tube racks
- wood splints
- sheets of paper
- pencils
- masking tape
- matches

Language Cards/Key Signs
chlorophyll
photosynthesis
sugar
to produce
respiration
a molecule

Identification Cards
Elodea
a test-tube
a test-tube rack
a wood splint
a rubber stopper
a beaker
masking tape

The Elodea plants should be healthy, actively growing ones. If you do not have any in a classroom aquarium, order some as close to the time of this activity as possible. Keep the plants in aquarium water under a strong light (100-150 watt bulb).

Background Information - You might want to demonstrate the proper way to set up the first part of the experiment. Be sure students place the Elodea sprigs in the test tubes correctly, so that the cut ends of the Elodea sprigs are at the bottoms of the test tubes. The oxygen bubbles will escape from the cut ends of the stems and collect at the bottoms of the test tubes. Students should be careful to get as little air as possible in their test tubes when they place the test tubes in the water-filled beakers. A small amount of sodium bicarbonate added to the water in the beakers will provide additional carbon dioxide for the Elodea sprigs to use in photosynthesis.

On the last day of the activity, demonstrate how to remove the test tubes from the beakers without letting any air into them. Show students how to test for the presence of oxygen with a glowing splint.

TEACHING SUGGESTIONS:

1. Begin the lesson by doing the experiment on page 35. Display all of the materials for the experiment. Have enough materials so that the students can work in pairs. Have the students name the materials and label them accordingly.

2. Read through the experiment with the students before they begin to do it. This activity will be done over a period of three or four days. Allow time each of these days for observation and discussion.

3. After the students have set up the experiment, have them read the beginning of section 2-3. Ask the students to explain each of the new vocabulary words. Give help where necessary. Also ask the students to explain the process of photosynthesis. Refer to Figure 2-6 during the discussion.

4. From the information in this section, ask the students to predict what will happen during the four days of their experiment.

5. At the end of the lesson, review the process of photosynthesis by having several students explain how plants produce their own food.

****

SECTION: 2.5 Life Activities
Page T-28/S-38 Organisms Exchange Gases With Each Other (40-45 min.)

TEACHING SUGGESTIONS:

1. Begin the lesson by writing the terms 'photosynthesis' and 'respiration' on the board. Ask a student to explain each process. Have a student go to the board and diagram the process by writing the elements involved and how they are involved.

Language Cards/Key Signs
photosynthesis
respiration

Identification Cards

2. Then have the students look at the two processes. Ask them if they can see any differences/similarities in the processes. (You will be trying to guide them to the conclusion that each is the reverse of the other.)

3. Also ask the students if there will come a day when there is not more oxygen for us to breathe. Have them prove their answer by using the information on the board.

4. Have the students open their books to page 38-39. Read the information with the students. Discuss the information in terms of their recent discussions of the two processes. Refer to Figure 2-9 in your discussion.

5. At the completion of the discussion, have the students observe the Elodea experiment. This is day two of this experiment. Discuss their observations and the possible reasons for what they are observing.

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SECTION: 2.5 Life Activities
Page T-28/S-40 Continued

PREREQUISITES: Basic information about the space program sending spacecraft to different planets.

ADVANCE PREPARATION: Materials - None.

TEACHING SUGGESTIONS:

1. Begin the lesson by discussing the photograph on page 40. Then read through the text with the students. Explain any new vocabulary words to them.

2. Discuss any questions which occur in the paragraphs.

3. At the end of the lesson, have the students observe the Elodea experiment. Discuss their observations, and reasons for these results. This is day three of the experiment.

Language Cards/Key Signs
a spacecraft
Viking
Mars
the horizon
soil
a molecule
an automatic device

Identification Cards

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SECTION: 2.5 Life Activities
Page T-28/S-41 (Continued) Highlights/Checkpoints

ADVANCE PREPARATION: Materials - The students should have their own paper and pencil to answer questions on the Checkpoints.

TEACHING SUGGESTIONS:

1. Complete the Elodea experiment. This should take about 25 minutes. Have the students read the paragraphs on page 36 and 37. Have them do the necessary things to complete the experiment. Discuss their answers.

2. Have the students read the Highlights. Discuss each point with them. Make sure that they can explain each concept listed. Ask different students questions about the concepts, to assure understanding.

3. Have the students take out paper and pencil. Read each question to the class. Have them write down their answers. Be sure that they understand the questions before writing their answers.

4. After they have completed their answers, discuss them.

5. Answers to Checkpoints (page 41).
    1. Living things perform five life activities, carry on respiraction, and are made of one or many cells.

    2. Materials move within plants. Green plants produce food by photosynthesis and release the energy from the food by respiration. Plants use stored food during respiration when photosynthesis is not taking place.

    3. Cells are the basic structures of organisms. Cells get energy from food through respiration.

    4. All organisms make carbon dioxide. Plants make food and oxygen during photosynthesis.

    5. When the leaves were destroyed, photosynthesis could not occur. Without photosynthesis, no sugar or starch was produced or stored in the roots.

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Level 7 Unit 1 Looking at Life

Chapter 2 Recognizing Life

Organization of Life

SECTION OUTLINE

Page	Section Number	Lesson Title	Teaching Time
T-28	2.7	You Can Look at Cells	50-55 min.
T-28	2.6	Cells Have Many Structures	40-45 min.
T-30	2.8	Organisms Have Different Levels of Organization	40-45 min.
NOTE: Sections 2.6 and 2.7 have been reversed.			

SECTION: 2.7 Organization of Life
Page T-28/S-45 You Can Look at Cells (50-55 min.)

PREREQUISITES: To correctly label the parts of the microscope. (See Appendix B). Familiarity with making microscope slides and looking at them with the microscope.

ADVANCE PREPARATION: Materials - See teacher's manual for listings of materials for the six experiments.
- Instruction sheet for label procedure.

Give each student a microscope, procedure sheet and materials for the six observations. If microscopes are limited, students could work in pairs.

Language Cards/Key Signs
a cell
a slide
a coverslip
a microscope

Identification Cards
(Labels for all things used in the six experiments.)

TEACHING SUGGESTIONS:

1. To begin the lesson, tell the students that they will be looking at different type of cells. Have them open their books to page 45-49 and look at the experiments listed on these pages. Take the students to each 'station' and read through the directions for the experiment with them. Make sure that they understand what is to be done.

2. Careful instructions should be given to the students about drawing pictures of the cells. Tell them to be as accurate as possible. Tell them to draw the structures just as they are shown with the microscope. Also tell them to be sure and label each picture because they will be used in the next lesson.

3. When you feel that the students understand what they must do, let one person go to each station and begin work. *You should move around the room helping where necessary.

4. At the end of this class, or the next day, discuss each of the six experiments and have the students display their drawings. The students can compare drawings and decide whose drawings were the clearest and the best representative of the actual cells.

*Some students may need assistance with CHEEK CELLS, they are very transparent and hard to see. Turn down the light as low as possible. Make sure they get only the single inside layer of the onion and spread it flat.

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SECTION: 2.6 Organization of Life
Page T-28/S-41 Cells Have Many Structures (40-45 min.)

ADVANCE PREPARATION: Materials - Drawings from the previous lesson. Each student should have six drawings of cells.

Also, make transparency/large drawings of each type of cell. Make labels but keep them separate from the pictures. Make ditto copies of each cell, listing the labels at the bottom of the page. The students can use these to practice learning the parts.

Language Cards/Key Signs
a structure
function
specialized
a cell membrane
cytoplasm
mitochondria
nucleus
nuclear membrance
chromosomes
a vacuole
a cell wall
cellulose
chloroplasts
a paramecium
cilia

Identification Cards
(same as language cards)
(labels for cells)

TEACHING SUGGESTIONS:

1. Have the students open their books to page 41. Read through the text with them. There are many vocabulary words in this section. Make sure that the students understand each new word as it occurs in the text.

2. As you are reading through the text, display the two pictures of the cells. As a term occurs in the text, have a student locate the structure in the picture(s).

3. Continue reading until the last paragraph on page 44. Stop here and review all of the terms and cell structures. Ask the students where the structures are located in the cells, and what the functions of the structures are.

4. When you have completed the review, go on to read about the paramecium. Discuss that in terms of the experiment with the pond water.

5. At the completion of the lesson, have the students take out their other drawings of cells. Have them label the parts of the cells which they have drawn. Move among the students, discussing their answers.

6. For further review, pass out the ditto copies of the cells. Tell the students to take the papers, and label the cells, check their answers in the book, and study the material. This could be done for homework.

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SECTION: 2.8 Organization of Life
Page T-30/S-50 Organisms Have Different Levels of Organization (40-45 min.)

PREREQUISITES: Previous study of the systems of the body, and labels for the organs in these systems.

Language Cards/Key Signs
a cell
a tissue
an organ
an organ system
an organism

Identification Cards
(Names of body systems)

ADVANCE PREPARATION: Materials - Pictures of a person, and the organ systems that make up a person. These can be displayed on a bulletin board at the end of the lesson. The display should include the labels as shown in Figure 2-19. The students can draw other pictures to fill in the chart.

TEACHING SUGGESTIONS:

1. Display the picture of the person. Ask the students what it is. The work you are looking for is an organism. Ask the students if they know what makes up an organism.

2. To stimulate discussion, begin showing pictures of body systems, one at a time. See if the students can name additional systems.

3. Then ask the students if they can name individual organs within these systems.

4. Have the students look at page 52, Figure 2-19. Explain that a person (organism) is made of many parts. These parts begin with the basic unit, the cell. Then a group of cells which function the same make up tissue, and so forth.

5. After discussing Figure 2-19, have the students read the text beginning at the second paragraph of the second column, page 50.

6. After the students have read the information, discuss the 'levels of organization' of an organism. Have them compare the pictures on page 51 and answer the questions.

7. At the end of the lesson, have the students read the Highlights. Discuss each point, and ask the students questions about them.

8. Then have the students write answers to the questions in Checkpoints. You can read the questions to the students if necessary. Move among the students to help them if they do not understand the questions.

9. After the students have completed their work, discuss their answers.

10. Do not do the Skullduggery section on page 53, as written, unless your students can read the sentences. As an alternative idea, rewrite the sentences, and have them answer, again filling in the blanks.

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Level 7 Unit 1 Looking at Life

Chapter 3 The Many Forms of Life

Sorting Things Out

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-33	3.1	Grouping is Organizing	40-45 min.
T-33	3.2	Grouping Things by Similarity	40-45 min.
T-33	3.3	Why Classify Living Things?	40-45 min.

NOTE: Begin to grow mold on bread as you start this chapter. Then it will be ready for discussion during the section on the Fungi Kingdom. Also begin to collect pictures of a wide variety of plants and animals for later use.

SECTION: 3.1 Sorting Things Out
Page T-33/S-58 Grouping is Organizing (40-45 min.)

PREREQUISITES: The ability to compare and contrast organisms.

ADVANCE PREPARATION: Materials -pictures of a variety of people

Take your class on a field trip and collect organisms. A park, meadow, vacant lot, etc., are all appropriate Maybe give a reward for the strangest organism.

Language Cards/Key Signs
to classify
an organism
similarity
a group

Identification Cards
(Labels for the organisms used in the lesson)

TEACHING SUGGESTIONS:

1. Use the collected organisms and some of your own (ex. Ameoba, coral, euglema, slime mold) to do an observation lab. Have data sheets where students can record observations of organisms.

2. Have students find ways to classify the organisms collected.

3. Use a follow up discussion to point out problems of classification and diversity of living things. Have the students look at page 58-61. Ask one student to read the titles of this section. Ask the class what will be the topic of discussion. Have the students look at Figure 3-1 and answer the questions. Then have them look at Figure 3-2 and do the same thing.

   Place pictures of people on a table. Have the students sit around the table. Ask them how they would classify these organisms and why. Ask the students if they think a classification system is important, and why?

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SECTION: 3.2 Sorting Things Out
Page T-33/S-62 Grouping Things by Similarity (40-45 min.)

ADVANCE PREPARATION: Materials -see teacher's guide for advance preparation for leaf experiment
-make xerox copies of Figure 3-3, one for each student, and make a transparency

Language Cards/Key Signs
a twig
Identification Cards
(Labels for kinds of twigs and leaves)

TEACHING SUGGESTIONS:

1. Begin the lesson by passing out the sets of leaves, one to each pair of students. Tell the students that they are to classify these leaves by their similarities and differences.

2. After they have observed the different types of leaves and discussed them with their partners, ask them if they can divide the leaves into two groups. Then those into two more groups.

3. As the students are working, encourage them to put their classification on paper, but do not let them refer to their textbook.

4. After the students have completed their classifications, have them compare theirs to others in the class. Discuss the differences. Show the students how to put their information into a chart, if they have not already done so. Choose one group's work and place the classifications on a chart on the board. Discuss this with the students.

5. Pass out the pictures of the twigs. Ask the studehts to classify these twigs and place their classifications on a similar chart. When the students have completed their work, ask them to look at their classification.

6. Again ask the students why classification is done and why scientists are concerned with a classification system.

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SECTION: 3.3 Sorting Things Out
Page T-33/S-63 Why Classify Living Things? (40-45 min.)

ADVANCE PREPARATION: See discussion, teacher's manual.

Language Cards/Key Signs
a beetle
to feature
to identify
wild mushrooms

TEACHING SUGGESTIONS:

1. Have the students read the information on page 63-64. Discuss the information, and the pictures on page 64.

2. Ask the students if they can give you other places where classification of objects is necessary, and why it is necessary.

3. Review the highlight section. Ask the students questions about each section of the highlights.

4. Have the students take out a piece of paper and a pencil. Explain the Checkpoints questions to them. Have them write their answers on their papers.

5. After the students have completed their answers, discuss them. (Note: answers to the Checkpoints questions are listed in the teacher's manual.)

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Level 7 Unit 1 Looking at Life

Chapter 3 The Many Forms of Life

Categories of Classification

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-34	3.4	You Can Classify Organisms	35-40 min.
T-35	3.5	A Species is One Kind	35-40 min.
T-35	3.6	Scientific Names are Useful	25-30 min.
T-35	3.7	Some Plants and Animals Don't Fit	25-30 min.

SECTION: 3.4 Categories of Classification
Page T-34/S-65 You Can Classify Organisms (35-40 min.)

ADVANCE PREPARATION: Materials -reproduce chart on pages 66-67

Language Cards/Key Signs
kingdom
phylum
class
order
family
genus
species

TEACHING SUGGESTIONS:

1. Explain to the students that scientists have developed a system of classification. They will be studying this system and the scientific method of naming organisms.

2. Read through section 3.4 with the students. As a new term appears discuss its meaning. As the classification terms appear, tape the language card to the board and discuss it. Be sure to discuss how each section of the classification hierarchy relates to each other section.

3. Tell the students that to help them understand scientific classification, you will give them an example. Discuss the dog. Discuss the reasons for each.

4. When you have finished talking about the dog, display the chart from pages 66-67. Discuss each animal. Ask the students if they can explain the reasons for grouping the organism in that particular way.

5. At the completion of the lesson, remove the language cards from the board. Ask one student to place the cards in the correct order and ask other students to explain each classification grouping.

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SECTION: 3.5 Categories of Classification
Page T-35/S-67 A Species is One Kind (35-40 min.)

ADVANCE PREPARATION: Materials -collect a variety of 'species' groups for the class to use in discussion

Language Cards/Key Signs
a species

TEACHING SUGGESTIONS:

1. Read the information on page 67 with the students. Be certain that they understand the concept of species and the two reasons for this type of grouping.

2. After the students have read the text, refer to the pictures on pages 68 and 69. Discuss the dogs, and the differences between the jaguar and cheetah. Again ask the students to explain the species grouping.

3. Show the students the pictures which you have collected. In the beginning, place all of the pictures together. Ask the students to place the pictures in species. Correct them where necessary. Then ask how these groupings relate to the two reasons for specied groupings. Continue that process until all of the students understand the concept.

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SECTION: 3.6 Categories of Classification
Page T-35/S-69 Scientific Names Are Useful (25-30 min.)

ADVANCE PREPARATION: Use some of the pictures from the previous lesson. Find out the scientific name for each organism. Be sure to include both plants and animals. Have a collection of books available for finding this information.

Language Cards/Key Signs
Latin
a scientific name

TEACHING SUGGESTIONS:

NOTE: The textbook need not be used for this lesson.

1. Review the classification hierarchy from lesson 3.4. Have the students explain each category.

2. Tell the students that each organism has a scientific name. Explain that the genus name (with a capital letter) followed by its species name (with all small letters) is that scientific name.

3. Show the students a picture from the previous lesson. Write the scientific name on the board. Tape the picture next to the name. Do that for some of the other pictures also.

4. Show the students other pictures. Have them name each organism. Write the names on the board. Ask the students to find the scientific name for each organism. They can do this in the classroom or in the library. When a student finds the name, he/she can write it on the board next to the name of the organism.

5. Ask the students what they think of the names. Explain the history of scientific names. Have them look at Figure 3-10 and discuss the usefulness of Latin scientific names.

6. Explain to the students that some common names of organisms are not clear, or are used for many different organisms. Thus, the need developed for scientific names. Tell them they are not required to memorize the names, just to be familiar with how they were developed.

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SECTION: 3.7 Categories of Classification
Page T-35/S-72 Some Plants and Animals Don't Fit (25-30 min.)

PREREQUISITES: Use of the microscope.

ADVANCE PREPARATION: Materials -make an infusion of pond H_2O and hay about 1 week in advance
-collect pond H_2O or other sources of stagnant H_2O
-collect information on people responsible for microscope work
Leeuwenhoek, Janssen 1590, Hooke, 1665, Malpighi

TEACHING SUGGESTIONS:

1. Do a microscope lab on microbes.

2. Have the students look at the one-celled organisms. Also have them draw the organisms. Ask the students to decide if they fit into the plant kingdom or the animal kingdom and why.

3. Have the students look at Figure 3-12. Ask which kingdom these organisms belong to. Discuss their answers.

4. Read through the text with the students. As you discuss the scientist who built a microscope, display the collection of information which you have found on him. Ask several students to volunteer to read the materials and report back to the class at the end of the chapter.

5. Be sure to emphasize the fact that the organisms are divided into five kingdoms.

6. Read through the highlights with the students. Question them on the information contained in each paragraph.

7. Explain each of the questions in the Checkpoints.* Have the students write their answers on paper. When they have completed their papers, discuss their answers. (Answers are in teacher's manual.)
*Omit questions 3 and 4.

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Level 7 Unit 1 Looking at Life

Chapter 3 The Many Forms of Life

The Smaller Organisms

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-36	3.8	The Moneran Kingdom	40-45 min.
T-36	3.9	The Protist Kingdom	40-45 min.
T-36	3.10	The Fungi Kingdom	40-45 min.
T-36	3.11	The Plant Kingdom	70-75 min.
T-37	3.12	The Animal Kingdom	70-75 min.
T-37	3.13	What Are Viruses?	30-35 min.
T-37	-	Working With Animals and Plants	55-60 min.
T-38	-	Highlights/Checkpoints	35-40 min.

SECTION: 3.8, 3.9, 3.10, 3.11, 3.12 The Smaller Organisms
Pages and times - see Section Outline The Moneran, Protist, Fungi, Plant, and Animal Kingdoms

ADVANCE PREPARATION: Materials
-Prepare a space for a large bulletin board to display the five kingdoms, pictures of representative organisms, and a listing of characteristics of each kingdom.
-Collect pictures of as many different organisms as possible to be placed on the mural during the lessons.
-Collect microscope slides and samples where appropriate.

Language Cards/Key Signs
(see separate listing at end of this lesson)

Identification Cards
(Labels for organisms on bulletin board)

TEACHING SUGGESTIONS:

NOTE: The activities/suggestions listed are for each section.

1. To begin each section, look at the pictured organisms. Discuss the variety of characteristics and reasons for grouping.

2. Read the text with the students. Explain all terms and use the language cards to reinforce the vocabulary.

3. For the Moneran, Protist, and Fungi Kingdoms, have prepared microscope slides or samples (moldy bread) for the students to observe and discuss.

4. Show the students the pictures and have them place them in the appropriate kingdom. Do this one by one, giving the students organisms and asking them if they fit the characteristics of the kingdom or not. Those that do fit

should be placed on the appropriate section of the mural and labeled.

5. As the students are discussing the placement of the organisms, have them generate a list of the characteristics of that kingdom. One student could copy this list and display it with the pictures.

6. Do the highlights and checkpoints section as they occur.

7. The following are additional activities that could be done during these five lessons:
   - -show captioned films on particular organisms
   - -look at additional microscope slides
   - -show a filmstrip on organisms
   - -have students write riddles about a particular organism and other students guess what it is
   - -have each student describe the placement of an organism and the reasons for that placement
   - -have the students match the name of an organism to a description of it
   - -choose one organism, and write an essay about it
   - -do a research project on an organism or kingdom and have the student report his/her findings to the class

8. After section 3.12, review and discuss the chart on page 94. This chart could be xeroxed and cut apart. The students could arrange it in proper order.

NOTE: A good source of pictures and information is: Cards of Knowledge
(Safari Cards)

Language Cards/Key Signs

3.8	monearans, bacteria, blue-green algae, peneumonia, tuberculosis, tetanus, gangrene
3.9	protists, moist, a flagellum, cilia, a paramecium, an amoeba, one-celled algae
3.10	fungi, a mushroom, to decay, mold, yeast, reproduction, gasohol, antibiotics, ringworm, athlete's foot
3.11	Many-celled algae, seaweed, moss, ferns, gymnospers, angiosperms
3.12	sponges, coelenterates, flatworms, round worms, segmented worms, parasites, hosts, molluscs, larva, echinoderms, arthropods, chordates, vertebrae, cartilage, vertebrates, invertebrates, amphibians, reptiles, cold-blooded, warm blooded, mammals

* * *

SECTION: 3.13 The Smaller Organisms
Page T-37/S-95 What Are Viruses? (30-35 min.)

ADVANCE PREPARATION: Materials
- -collect any variable material on viruses.
- -collect pamphlets that explain the diseases listed in the section
- -draw a large picture of a cell on the board

Language Cards/Key Signs

a virus
to damage
mumps
a molecule
a cell
influenza
polio
respiration

TEACHING SUGGESTIONS:

1. Begin the lesson by reviewing a cell and its structure. Refer to the large picture of the cell to discuss its parts and their functions.

2. Read the text with the students. Explain each new vocabulary word as it occurs. As the text explains that a virus gets into the cell, use the picture on the board to show this in a graphic way.

3. After reading the text, review what is known about viruses. Have the students list the various diseases caused by viruses. Ask the students if they would be interested in finding out more about the particular diseases. Have several volunteers take the information which you have collected, and prepare a short report that could be given to the class on the following day.

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SECTION: 3.13 The Smaller Organisms
Page T-37/S-96 Working With Aniamls and Plants (55-60 min.)

ADVANCE PREPARATION: Materials -contact several individuals in your area, one that works with animals and one that works with plants. Invite them to come to your class and discuss their careers, and the background necessary to go into such a career.

Language Cards/Key Signs
a career
a trained assistant
a veterinarian
biology
zoology
a nursery

TEACHING SUGGESTIONS:

1. At the beginning of class, have the students give their reports on viruses.

2. Read through the text with the students. Tell them that two people will be coming to visit the class and discuss their jobs.

3. Have the class develop a list of questions that they would like to ask the individuals.

4. Have the visitors come to class the following day. Allow them to discuss their jobs, and then let the students ask their prepared questions and any other questions that they have.

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SECTION: 3.13 The Smaller Organisms
Page T-38/S-97 Highlights/Checkpoints (35-40 min.)

TEACHING SUGGESTIONS:

1. Review the highlights with the students. Ask them questions on each piece of information.

2. Have the students write answers to the questions in Checkpoints. If necessary, reword the questions and explain where necessary.

3. After the students have completed their answers, discuss them.

4. The Skullduggery section is optional. The use of this would depend on the language level of the students in your class.

5. Be sure to go through the What's Next? section and discuss the information listed there. This leads into the next unit and chapter.

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Level 7 Unit 2 Life Systems

Chapter 4 Support Systems

Organisms Without a Framework

SECTION OUTLINE

Page	Section Number	Lesson Title	Teaching Time
T-41	4.2	You Can Observe Amoeba and Paramecium	50-55 min.
T-41	4.1	Protists Move in Different Ways	50-55 min.
T-42	4.3	Movement Varies in Soft-bodied Animals	50-55 min.
NOTE: Introduction has been omitted. Sections 4.1 and 4.2 have been reversed.			

SECTION: 4.2 Organisms Without a Framework
Page T-41 You Can Observe Amoeba and Paramecium (50-55 min.)

PREREQUISITES: Proper use of the microscope and proper slide production.

ADVANCE PREPARATION: Materials - See teacher's manual for listing of materials and directions for experiments.

Language Cards/Key Signs
an amoeba
a paramecium
low magnification
high magnification
field of view

Identification Cards
(Labels for materials in experiment)

TEACHING SUGGESTIONS:

1. Display all of the items for the experiment including the microscopes. Have the students name each item, using the identification cards. Label any that they do not know.

2. The students should then read the experiment on page 106. NOTE: If the language of the text is too difficult, rewrite the directions for the experiments on a chart or transparency. Then the students can read the directions from this.

3. The students should perform the two experiments. Making the necessary drawings.

4. At the end of the lesson, have the students compare their drawings and discuss what they saw. Place special emphasis on the movement of the organisms.

5. Review all of the names for materials at the end of the lesson.

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SECTION: 4.1 Organisms Without a Framework
Page T-41/S-104 Protists Move in Different Ways (50-55 min.)

ADVANCE PREPARATION: Materials - plain paper for drawings

Language Cards/Key Signs
protists
cytoplasm
cilia
a flagellum

Identification Cards

TEACHING SUGGESTIONS:

1. Begin the lesson by reviewing the students findings of the previous lesson. Be sure that the students can name the organisms which they were observing.

2. Read through the text with the students. Have the students compare what they are reading to what they observed previously.

3. Read through all of the material. Discuss the movement of cilia and flagella.

4. At the end of the lesson, ask the students to draw a picture of an amoeba and a paramecium, labeling all of the parts. If there are some parts which they cannot remember, refer them to chapter 3 or to the encyclopedia.

* * *

SECTION: 4.3 Organisms Without a Framework
Page T-42/S-107 Movement Varies in Soft-Bodied Animals (50-55 min.)

ADVANCE PREPARATION: Materials - If possible, get a movie on these organisms, or set up a salt water aquarium. Depending on the season, try and find a few earthworms for the class. The earthworms can be put in dirt with corn meal sprinkled on the top.

Language Cards/Key Signs
a jellyfish
a squid
tentacles
a muscle
cartilage
a clam
an earthworm
bristles

Identification Cards
(Labels for organisms used in the classroom)

TEACHING SUGGESTIONS:

1. If you have a movie or actual organisms to watch, do this before beginning the lesson. Allow the students the opportunity to observe and comment on the movement of the organism(s).

2. Read through the text with the students. Have them answer the questions in the text as they go along.

3. If possible, while reading the section on the earthworm, have the students observe the movements of several worms.

4. At the completion of the lesson, read through the Highlights section. Ask the students questions about each important point.

5. Have the students write the answers to the Checkpoints questions. After the students have completed their papers, discuss their answers. NOTE: If question 4 is too difficult for the students to do individually, use it as a discussion question to wrap up the section.

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Level 7 Unit 2 Life Systems

Chapter 4 Support Systems

Skeletons

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-43	4.4	Skeletons Support and Allow Different Movements	60-70 min.
T-43	4.5	Arthropods Have Outside Skeletons	50-55 min.
T-43	4.6	Vertebrates Have Internal Skeletons	50-55 min.
T-43	4.7	Joints Allow Movement of Skeletons	65-70 min.
T-44	4.8	Internal Skeletons Grow	50-55 min.
T-44	4.9	How Big Can An Animal Be?	35-40 min.

SECTION: 4.4 Skeletons
Page T-43/S-110 Skeletons Support and Allow Different Movements (60-70 min.)

PREREQUISITES: Visit a museum that shows skeletons or look at pictures of skeletons.

ADVANCE PREPARATION: Materials - Collect pictures of skeletons, or have real skeletons or bones on hand, or plastic models of skeletons. If possible, before the lesson, visit a museum that has skeletons. Have the students observe the structures of the various animals and notice how the bones come together at joining points.

Language Cards/Key Signs
a skeleton
framework
internal
the skeletal system
weightless

TEACHING SUGGESTIONS:

1. Begin the lesson by displaying the pictures/models/bones which you have collected for the class. Ask the students what animals they come from.

2. Read through the text with the students. Be sure to emphasize that the skeleton supports and protects the organs of the animal.

3. Find out what the students know about external skeletons and internal skeletons. Tell the class that they will be discussing different structures which support the bodies of organisms.

4. Have the students look at Figure 4-7. Answer the questions that go with the picture.

5. Tell the students that they will be studying about skeletal systems. They can bring in any bones which they have collected to add to your display. Begin to label the bones/models/pictures.

NOTE: An excellent source of pictures of skeletal systems of organisms is the ESS book on Bones (Webster Division, McGraw-Hill Book Company, New York); Elementary Science Study Curriculum; Picture Packet for Bones, Bone Picture Book. See also Teacher's Guide for Bones and How to Make a Chicken Skeleton.

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SECTION: 4.5 Skeletons
Page T-43/S-111 Arthrops Have Outside Skeletons (50-55 min.)

Language Cards/Key Signs
an exoskeleton
a joint

ADVANCE PREPARATION: Materials - If possible, collect crayfish from a nearby stream, or order them from Carolina Biological Supply. They can be set up in an aquarium with rocks in the bottom and 5 to 10 cm of water. Add an air pump to the tank. Place rocks in the aquarium as well as inverted flower pots with a doorway cut out for the crayfish to hide in. Crayfish eat water plants, earthworms, or raw fish. They only need to be fed once a week. If crayfish are not possible, see about finding a lobster exoskeleton.

TEACHING SUGGESTIONS:

1. Allow the students to observe the structure of the crayfish. If you were unable to find crayfish, move on to step 2.

2. Display the lobster exoskeleton and some mollusc shells. Ask the students to observe the two items. The students can compare the shells. Ask them to discuss the advantages and disadvantages of each type of covering.

3. Read the text with the students. Be sure that they understand the comparisons in Figure 4-8.

4. In their discussion about the clam shell and the lobster shell, the students might have mentioned joints. Emphasize that when it is read in the text. Ask them where they have joints and how they help them to move.

5. Review the vocabulary from this lesson and the previous lesson.

****

SECTION: 4.6 Skeletons
Page T-43/S-112 Vertebrates Have Internal Skeletons (50-55 min.)

Language Cards/Key Signs
a vertebrate
an internal skeleton
cartilage
the vertebral column
the skull
the breastbone

Identification Cards
(Labels for human skeleton)

ADVANCE PREPARATION: Materials - Buy a fish and cook it before class. Make a copy of Figure 4-10 without the labels. Make a large drawing of the human skeleton. Make labels for the picture.

TEACHING SUGGESTIONS:

1. Display the fish (with the meat still on the bones). Place the fish on a table. Have the students sit around the table. Depending on class size, you might want to have several fish.

2. Have the students carefully take off the meat. As the meat is removed, have them observe the skeletal structure of the fish. When the students have finished you should have the entire skeleton. This could be glued or wired to a piece of heavy cardboard for display.

3. Read through the text with the students. Be sure to emphasize the difference between bone and cartilage.

4. Have the students answer the question for Figure 4-9. Also have the students compare the skeletons in Figure 4-9 to the human skeleton in Figure 4-10.

5. Have the students look carefully at the labels in Figure 4-10. Discuss each labelled bone.

6. Place the large picture of the skeleton on the board. Have the students close their books. Ask them to place the labels in the correct places.

7. At the end of the lesson, pass out the worksheets with the picture of the skeleton. Have the students label the picture.

* * *

SECTION: 4.7 Skeletons
Page T-43/S-114 Joints Allow Movement of Skeletons (65-70 min.)

ADVANCE PREPARATION: Materials - Find a movie about joints, (Captioned Films). Buy one or two chickens (depending on class size). Cook the chicken(s) before class. If they are boiled for several hours the meat will come off the bones. Run off more copies of the picture of the human skeleton, without labels.

Language Cards/Key Signs
a joint
a hinge joint
a ball-and-socket joint
a gliding joint
a disc
a fixed joint
a ligament

TEACHING SUGGESTIONS:

1. Place the chicken(s) on dissecting trays or plastic plates. Tell the students that they will be looking at joints. Review the meaning of the word joint, which was included in a previous lesson.

2. The students should look at the skeleton and locate the joints. If the skeleton has come apart, the students should try and find the pieces which fit together. Ask the students to find different kinds of joints.

3. Read through the text with the students. As each joint is mentioned, have them attempt to find it on the chicken. Also ask students if they can locate that type of joint on themselves.

4. After reading the text, ask the students to name different kinds of joints on their bodies.

5. After doing this as a group, pass out the worksheet of the human skeleton. Ask the students to label the joints. They should write the type of joint along with the name, e.g. hings joint - elbow. Discuss their answers.

6. For further discussion, talk about surgical replacement of worn or injured joints with artificial joints. Students may know of people who have had this type of surgery. The most commonly replaced joints are the hip, knee, and elbow. Replacement joints are made ot special metals and plastics designed to withstand stress and constant use over a long period of time.

7. As a follow-up activity, ask each student to choose one type of joint. Tell them to make a model of the joint. These should be labelled with the joint name and brought to class when completed.

* * *

SECTION: 4.8 Skeletons
Page T-44/S-115 Internal Skeletons Grow (50-55 min.)

ADVANCE PREPARATION: Materials - Go to your local grocery store and ask the meat manager for a large animal bone. Ask the manager to saw the bone in half lengthwise. Also, hopefully the crayfish are still alive and possibly they have molted - a fascinating event to observe. Have microscopes, slides, eye droppers and coverslips, as well as prepared slides of bone cells.

Language Cards/Key Signs
a tissue
a bone cell
calcium
a blood vessel
bone marrow
molting

TEACHING SUGGESTIONS:

1. Ask the students what they think bones are like. Ask them if the bones are hard all the way through.

2. Show the students the animal bone. Allow time for the students to touch the bone and observe its structure. Have one students draw a picture on the board of what he/she sees.

3. Ask the students to take out the microscopes and pick up slides, coverslips, and eyedroppers. Tell the students that they can attempt to look at bone cells by making their slides. Also display the prepared slides, which the students can use in addition to their own.

4. Discuss the students' findings when looking at the bone cells. During their observations, ba sure that they take tissue from the different parts of the bone. Discuss the similarities and differences of these tissues.

5. Read through the text with the students. Discuss the vocabulary as it occurs. Refer to Figure 4-13 when discussing the parts of the bone.

6. At the end of the lesson again ask the students what bones are like. Have the students describe the structure of a bone.

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SECTION: 4.9 Skeletons
Page T-44/S-117 How Big Can An Animal Be? (35-40 min.)

TEACHING SUGGESTIONS:

1. Read through the text with the students. Discuss the possibilities listed in the text for sizes of animals.

2. Read through the Highlights section with the students. Ask them questions about each important point.

3. Have the students answer the Checkpoint questions. These should be done in a discussion. Have one student answer a question and then have the other students comment on the question. To review the material further, repeat some of the questions asking different students.

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Level 7 Unit 2 Life Systems

Chapter 4 Support Systems

Muscles

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-44	4.10	Muscles Move the Skeleton	65-70 min.
T-44	4.11	Muscles Have Special Functions	50-55 min.
T-45	4.11	Repairing Sports Injuries	50-55 min.

SECTION: 4.10 Muscles
Page T-44/S-118 Muscles Move the Skeleton (65-70 min.)

PREREQUISITES: Proper techniques for dissection.

ADVANCE PREPARATION: Materials - Buy one or two chickens to be used in the dissection. Make a copy of the pictures in Figure 4-18 without the labels. Make enough for each student. For the dissection, have dissection trays, pins, and instruments for each chicken. Two or three students can work on the same specimen.

Language Cards/Key Signs
- a muscle
- a muscular system
- to contract
- a tendon
- a ligament
- the biceps muscle
- the triceps muscle
- to relax

TEACHING SUGGESTIONS:

1. Pass out the dissecting equipment and the chickens. Tell the students that they will be studying about muscles. Have the students carefully pull back the skin on the chicken leg, move the leg and look at the action of the muscles. Then allow the students to explore other parts of the chicken's body, looking for different kinds of muscles. Move among the students as they work, helping them to identify different types of muscles.

2. Have the students look at Figure 4-16. Ask the students the name of this system. Use the language card to reinforce the system name. Point out the muscles and the function of each one as listed in the picture. Allow the students to perform the action indicated and feel the muscle movement.

3. Begin reading the text with the students. Read the first two paragraphs.

4. Then have the students look at Figure 4-15 and discuss the pictures. Have them do the comparison noted under the pictures.

5. Then have the students look at Figure 4-17, 4-18, and 4-19. Explain the movement of muscles, as is listed in the text, but do not read through the text with the students. The students can move their own bodies to correspond to the pictures, feeling the muscles during the movement.

6. Read the last paragraph in the section with the students. Review the vocabulary and the functions of the muscles listed.

7. Pass out the pictures and ask the students to label the biceps, triceps, and tendons in the pictures without looking at the book.

* * *

SECTION: 4.11 Muscles
Page T-44/S-122 Muscles Have Special Functions (50-55 min.)

ADVANCE PREPARATION: Materials - Have prepared slides of muscle cells and microscopes ready before the class begins.

Language Cards/Key Signs
voluntary muscles
a striated muscle
involuntary muscles
smooth muscle
cardiac muscle

TEACHING SUGGESTIONS:

1. Have the students look at the prepared slides of muscle cells. Ask the students to diagram what they see. As they are looking at the slides, ask the students to compare the different cells. Discuss their observations.

2. Read through the text with the students. Refer to the slides when discussing the muscle cell types. Have the students identify the muscle cells in their drawings and label them. The students should also note if the muscle cells are voluntary or involuntary.

3. Make a chart on the board with the following headings:

Muscle Location	Voluntary/Involuntary

Ask the students to think about the different parts of their bodies. Fill in the chart as a group, discussing each student's ideas.

4. Discuss the Highlights. Ask the students questions on the important points. Have the students write the answer to the Checkpoint questions. When they have completed their answers, discuss them.

* * *

SECTION: 4.11 Muscles
Page T-45/S-125 Repairing Sports Injuries (50-55 min.)

ADVANCE PREPARATION: Materials - Ask a doctor, nurse or physical therapist to visit your class to discuss sports injuries, their prevention and rehabilitation.

Language Cards/Key Signs
an injury
a physical therapist
a researcher
surgery
certification

TEACHING SUGGESTIONS:

1. Read through the section with the students. This section contains many new ideas. Be sure that the students understand the concepts by asking questions throughout the section.

2. Invite a doctor, nurse or physical therapist to visit your class. Have them discuss how to prevent injuries, explain the importance of warm-up exercises, the treatment of injuries and the rehabilitation of injuries.

* * *

Level 7 Unit 2 Life Systems

Chapter 4 Support Systems

Plant Support

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-45	4.12	Water Organisms Stay Near The Surface	55-60 min.
T-45	4.13	Land Plants Have Support Structures	60-70 min.
T-46	4.13	Evaluation	20-25 min.

SECTION: 4.12 Plant Support
Page T-45/S-126 Water Organisms Stay Near the Surface (55-60 min.)

ADVANCE PREPARATION: Materials - Bring in different types of water plants. Some could be purchased at a pet store. These can also be ordered from a biological supply house.

Language Cards/Key Signs
photosynthesis
shallow water
a holdfast
an air bag

TEACHING SUGGESTIONS:

1. The students should first observe the water plants which you have collected. You should ask them questions about photosynthesis, how plants live in water, and if they stay near the top of the water or near the bottom. Have the students develop a hypothesis about their position in the water.

2. Read through the text, with the students. See if the students can locate information which would prove or disprove their hypothesis.

3. At the end of the lesson, ask several students to explain why water plants stay near the top of the water.

****

SECTION: 4.13 Plant Support
Page T-45/S-127 Land Plants Have Support Structures (60-70 min.)

ADVANCE PREPARATION: Materials - Have several potted plants on hand which wilt easily. Also collect all of the materials necessary for the experiment on pages 130-131. These are listed in the teacher's manual. Rewrite the directions for this experiment on a chart/transparency. Make copies of the chart from page 131, one for each student. Have a cross section of a tree trunk on hand for the last part of this section.

Language Cards/Key Signs
nonwoody plants
to wilt
woody plants
bark
cambium
xylem
cellulose
lignin

TEACHING SUGGESTIONS:

1. Begin the lesson with the celery experiment. Place the chart on the board. Have the students read through the directions and then perform the experiment. Pass out the chart for the students to fill in as the experiment is progressing.

2. While the experiment is going on, begin reading through the text with the students. Stop to fill in the chart for the experiment and continue reading the material.

3. When discussing the wilted plant, show the students your plants which are wilted. Have the students water them and record their observations at five minute intervals, the same as the other experiment. They need not measure, but just write down what is happening to the plant.

4. Show the students the cross section of the tree trunk. Discuss the different structures which are observable. Talk about the growth rings and what can be learned from studying them.

5. Read through the section on the tree which begins on page 130. Have the students point out the different parts of the trunk on the cross section as they are talked about in the text.

6. At the end of the lesson, discuss the results of all of the experiments. Have the students give their reasons for the results.

****

SECTION: 4.13 Plant Support
Page T-46/S-133 Evaluation (20-25 min.)

ADVANCE PREPARATION: Materials - Make a copy of page 134, making enough for each student

TEACHING SUGGESTIONS:

1. Read through the Highlights with the students. Ask them questions on each important point.

2. Have the students write the answers to the Checkpoints. When they have completed their work, discuss their answers.

3. Read through the Skullduggery with the students. Have them decide as a group what the correct answer is. Tell them if they are right or wrong.

4. Pass out the copies of page 134. Instruct the students to cut out the bones from the cat. Have them put the skeleton together. (They need not use the Skullduggery answers to guide them, if that is too confusing.)

5. Read through What's Next, and discuss the information.

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Level 7 Unit 2 Life Systems

Chapter 5 Digestion and Excretion

Breaking Down Food

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-49	5.1	Why Do Organisms Need Food?	40-45 min.
T-49	5.2	Many Substances are Found In Food	90 min.
T-52	5.3	How Does Food Get Into Cells	90 min.
T-52	5.4	Enzymes Do the Work	45-50 min.
		(next day)	20-25 min.
		(third day)	20 min.
T-54	5.5	The Energy In Food Can Be Measured	90 min.
T-54	5.6	A Balanced Diet Is Important	90 min.

SECTION: 5.1 Breaking Down Food
Page T-49/S-139 Why Do Organisms Need Food? (40-45 min.)

ADVANCE PREPARATION: Materials - Read through the material in Chapter 2. Part of this lesson will be a review from this chapter. If possible, have a classroom pet on display during the lesson.

Language Cards/Key Signs
energy
reproduction
a cell
digestion
excretion

TEACHING SUGGESTIONS:

1. The teacher should begin the lesson by telling the students that they will be studying the topics of digestion and excretion. The teacher should write the terms digestion and excretion on the board and explain them to the class.

2. The teacher should refer to the classroom pet and ask, what things are necessary for this animal to live? When a student discusses the need for food, ask what that food supplies to the organism.

3. Read the information on page 140 to the class. Review the concepts from Chapter 2 on food and energy.

4. NOTE: The beginning of this section has been omitted.

5. At the end of the lesson, the teacher should explain to the students that they will be learning about foods. The students are to keep a log of the foods that they eat everyday. The students should take several sheets of notebook paper, one for each day in which they will be writing their log. They should head the paper with their name and the appropriate date. They should write Breakfast, Lunch, and Dinner on the paper, leaving enough room in between for them to write in the foods that they have eaten for that meal. This log should be continued daily until section 5.6 has been completed.

* * *

SECTION: 5.2 Breaking Down Food
Page T-49/S-140 Many Substances Are Found In Food (90 min.)

Language Cards/Key Signs
nutrients
proteins
fats
carbohydartes
starch
sugars
Identification Cards
(Labels for all items used in experiments)

ADVANCE PREPARATION: Materials - See Teacher's Manual for specific information on the two experiments. The teacher should write the directions for the experiments on a transparency/chart using language appropriate to the students. The teacher should also copy the charts on pp. 142-143 and put them on a ditto. Each student should have four copies of Figure 5-4 and one copy of Figure 5-5. When copying Figure 5-4, omit the labels for the substances, just number them and have the numbers correspond to numbers on the containers holding the substances.

TEACHING SUGGESTIONS:

1. The teacher should display all of the materials necessary for the experiment. The labels should also be displayed. The class should discuss each material and practice saying/signing the words. The chart on the experiment should be displayed on the board.

2. The teacher should pass out the worksheets (Figure 5-4) and show the students how the numbers on the worksheet correspond to the numbers on the containers.

3. The teacher should explain to the students that they will be doing experiments with food substances. They will discuss the names for the substances at the end of the lesson. The purpose of the experiments is to find out which of the tests will show the presence of a particular food substance. The students should do the experiments and record the results on their worksheets. They should read the directions for the experiment from the chart.

4. The students could work in pairs or 'teams' to conduct the experiments. After they have completed the worksheets, the results should be discussed. The teacher should ask the students to match up the test substance with the food substance which it tests for.

5. The teacher should then read the first paragraph of this section (page 140) with the students. The teacher should explain which numbered substances correspond to the names - protein, fat, carbohydrate (sugar/starch). The students should look at Figure 5-3, and discuss the foods found in each of the three groups.

Day 2

1. The chart on experiment two can be placed on the board. The food substances that are being used should be displayed with proper labels. The other equipment for the experiment should also be on display. The teacher can begin the lesson by asking the students to label the materials, and to explain which substance was to be used to test for which food substance.

2. The students should read the directions for the experiment. They should take a worksheet. They can work in pairs or 'teams' as before. They should test each substance and record their results on the worksheet of Figure 5-5.

3. When the students have completed their tests, the class should discuss the results.

4. The teacher could request that the students bring in other substances which they might want to test. These could be tested at another time.

* * *

SECTION: 5.3 Breaking Down Food
Page T-52/S-143 How Does Food Get Into Cells? (90 min.)

PREREQUISITES: Labeling the parts of the cell explaining the function of the cell membrane.

ADVANCE PREPARATION: Materials - See Teacher's Manual for experiment on diffusion. Also set up the sugar experiment with a glass of water, a sugar cube, and a spoon for each student. Make a model of a large cell, as in Figure 5-6. Cut the molecules from cardboard. Make two sets of molecules, separate ones as in Figure 5-7. Make sure the molecules are different shapes as they are in the two figures.

Language Cards/Key Signs
a molecule
a cell membrane
diffusion
a space

TEACHING SUGGESTIONS:

1. Begin the lesson by reviewing the parts of a cell. Ask a student to draw a cell on the board, including all of the parts. Ask another student to label the parts of the cell.

2. The teacher should ask, Where do organisms get energy? Does a cell need energy? How does a cell get that energy? Allow the students time to discuss these questions without telling them if they are completely correct in their answers.

3. The teacher should then explain to the students that cells do need energy and that food does go into the cells. The teacher should remind the students of the actual size of a cell.

4. The teacher can display the outline of the cell (membrane) with the spaces (from Figure 5-6). The teacher should explain with the spaces (from Figure 5-6). The teacher should explain that the picture represents the cell membrane. The questions should again be asked, How does food get into the cell?

5. After discussing the possible ways food could get into the cell, the teacher should show the students the moelcules. The teacher should ask a student to demonstrate how the molecules get into the cells. The teacher should pose the problem of the molecule which is too large.

6. When the students understand the movement of molecules in the cells the teacher should bring out the two demonstrations (potassium permanganate, and sugar). The teacher should explain to the class that they will be observing the experiments and discussing the results. Begin the potassium permanganate experiment first. Have the students make an initial observation of the experiment. Then begin the sugar experiment, allowing the students to take small tastes of the water from the top of the glass to see if they taste any sugar. These experiments should be continued as the lesson progresses, stopping the lesson at various intervals for further observation. Note: another experiment which could be done in the classroom is to spray perfume at one end of the room, and ask the students to raise their hands when they smell the perfume.

7. The teacher should write the word diffusion on the board. This term can be explained using the cell model and the molecules. The students can look at Figure 5-6 and answer the questions, Which molecules are diffusing into the cell and which are diffusing out of the cell?

8. Final observations of the experiments should be made at the end of the class. The connection should be made between the experiments and the term diffusion.

Day 2

1. The teacher should begin the lesson by reviewing the concepts taught previously. The teacher should ask a student to explain how food gets into the cells. Another student could be asked to explain the term diffusion. A discussion of the previous day's experiments should take place to review the experiments as examples of diffusion.

2. Using the cell model from the previous lesson, the teacher should display the large chains of molecules. The teacher can ask the students how these molecules can get into the cells. The students can look at Figure 5-8 to see which molecules go with which food substance.

3. The teacher should ask the students again, How can these chains of molecules get into the cells. The possibilities should be discussed. The teacher should explain which possibility is correct.

4. The teacher should read the last two paragraphs on page 144 continuing to page 145. The class should again discuss the concept that the molecules are broken down in the body.

5. At the end of the lesson, the teacher should review the concepts of diffusion and digestion.

6. NOTE: Leave the experiment with the soda crackers/saliva until the next lesson.

****

SECTION: 5.4 Breaking Down Food
Page T-52/S-146 Enzymes Do the Work (45-50 min. and 20-25 min.)

ADVANCE PREPARATION: Materials - See Teacher's Manual for listing of materials and procedures for the two experiments. Write out the directions for the experiments on chart paper/transparency. NOTE: In the starch/sugar experiment (section 5-3) use both the crackers and the raw potato.

Language Cards/Key Signs
saliva
soda crackers
an enzyme
digestive enzymes
gelatin
a petri dish

Identification Cards
(Labels for all things used in the experiments)

TEACHING SUGGESTIONS:

1. The teacher should display the materials for the first experiment on a table in front of the class. The students should label each object used in the experiment. (Include the materials for testing the presence of sugar/starch.) Review the tests used previously for the presence of sugar or starch.

2. The students should take one cracker and one piece of raw potato. The teacher

should place the chart on the board. The teacher should instruct the students to read the directions from the chart.

3. The students should, as a group, chew on the crackers and then discuss the results. After the discussion, the students should be allowed to test for sugar/starch in the cracker, saliva, and then the partially digested cracker.

4. Next the students should chew the piece of raw potato and then follow the same sequence of discussion and experimentation as they did with the cracker.

5. The teacher should read the first paragraph of section 5-4 to the class, explaining the vocabulary as appropriate. Then the class should discuss the information and define the terms used in the paragraph.

6. The teacher should then display the chart for the next experiment as well as the materials. Again the students should label the materials. The class should read through the directions as a group. The teacher should make sure that the students understand the directions by questioning them on the steps to follow.

7. The students should work in pairs and complete the first part of the experiment. The other parts will be completed during the next two days.

8. The teacher should review the new vocabulary from the section and have the students define the terms.

****

SECTION: 5.5 Breaking Down Food
Page T-54/S-147 The Energy in Food Can Be Measured (90 min.)

PREREQUISITES: The ability to multiply and divide, as well as do column addition.

ADVANCE PREPARATION: Materials - See Teacher's Manual for a listing of materials needed for the demonstration. Also collect 'calorie counters' for the students to use during the two days. Write the formula for finding the number of calories on a transparency/chart. If appropriate give the students various data to put into the formula and find out numbers of calories for particular goods. Make a ditto of the chart (see back). Make enough to give each student 5 copies.

Language Cards/Key Signs
a calorie
weight
weight gain
weight loss

TEACHING SUGGESTIONS:

1. The students should be asked to look at page 148. The teacher should ask the students if they know what calories are and why they are listed on this chart. Discuss the term calories and explain what it means if the students are unfamiliar with the term.

2. The teacher should conduct the demonstration experiment, explaining to the class as the teacher proceeds through the experiment, what is being done and why. The formula for finding calories should be on display. When the teacher has completed the nut burning, the students should figure out the number of calories. Follow the same procedure for the sugar cube burning.

3. If it is appropriate to the students' mathematics skills, the teacher should give them additional data to plug into the formula.

4. The students should observe the changes in the gelatin from the previous day's experiment. They should discuss the changes and the possible reasons for them.

Day 2

1. The teacher should ask the students to take out their food log that they have been keeping since the beginning of the chapter. The teacher should pass out the following form and the students should write the various foods on the form.

2. Next the students should look at the chart in the book and/or booklets on Calories and write in the number of calories for each of the foods, on their charts.

3. When the students have completed their charts, they should add the number of calories consumed for each day of their log.

4. The teacher and students should read the text for section 5-5 from the beginning to the second paragraph on page 149. As the students are reading the information, they should be relating it to the demonstration of the previous day and to their listing of calories on their charts.

5. The teacher should take the information in the last part of this section on weight loss and gain and explain it to the class using specific examples. The text need not be used for this explanation. These examples should be written on the board, and the students should be asked to compute the difference between calories used and calories consumed. The teacher should continue giving examples until the students understand the relationship of calories and weight gain or loss.

6. At the end of the class, the students should again observe the gelatin/protein experiment and discuss the results. Refer back to page 147 for appropriate questions on the experiment.

Chart for students

FOOD EATEN	NUMBER OF CALORIES	VITAMINS/MINERALS IN FOOD

****

SECTION: 5.6 Breaking Down Food
Page T-54/S-150 A Balanced Diet Is Important (90 min.)

ADVANCE PREPARATION: Materials - Cut out a variety of pictures of foods from the three groups. Mount each picture on cardboard and leave room on the cardboard for the students to write the name of the food. Make a worksheet with a chart for the students (see example). Make enough copies to give each student three copies.

Language Cards/Key Signs
vitamins
minerals
protein
carbohydrates
fats
a disease
a balanced diet

Identification Cards
(Labels for foods used in lesson)

TEACHING SUGGESTIONS:

1. The teacher should begin the lesson by passing out the food samples. The students should take turns labeling them.

2. The teacher should then ask the class to design some

'good meals.' The teacher can tape the pictures of the foods which are chosen, in a group, on the board. The students should make up four or five different meals.

3. The teacher should then explain that it is important to have a balanced diet. The teacher should ask the students what they think should be a part of a balanced diet. As the students discuss them write the terms protein, carbohydrate and fat on the board. The teacher should tell the students that there are other important parts of a balanced diet. These are vitamins, minerals, fiber, and water. Add these to the list on the board.

4. The teachers should then pass out the worksheet with these labals on it. The students should copy the foods which they have grouped into meals. Then they should put a check under the appropriate column(s). When the students have completed the worksheet, they should discuss the meals. The teacher should point out that a balanced diet means having some of each group. The students should check to see if their meals were balanced of not and if not, why not.

5. The students should then read the information in section 5-6. When discussing the section on a balanced diet, ask one of the students to explain what is meant by this term.

6. Discuss each chart carefully, having the students read about each vitamin and mineral, where they are found and how they help the body.

7. The students should take out their log-charts from the previous lesson. They should fill in the information on vitamins and minerals.

8. For further review of the balanced diet, the students can take their own food consumption, and place the items on the chart with the headings Protein, Carbohydrates, etc. They can evaluate if they are eating a balanced diet.

Day 2

1. The students should read the Highlights section. The teacher should ask the students questions on the concepts taught in this section.

2. The students should, on their own paper, answer the questions in Checkpoints. The teacher can paraphrase or reword the questions if necessary.

3. When the students have completed their answers, the class should discuss the questions and answers.

WORKSHEET

Food	Protein	Carbohydrates	Fats	Fiber	Water	Vitamins	Minerals

* * *

Level 7 Unit 2 Life Systems

Chapter 5 Digestion and Excretion

Digestive Systems

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-55	5.7	Digestion in a Small Animal	45-50 min.
T-55	5.8	Large Organisms Have Digestive Systems	90 min.
T-55	5.9	Plants Also Digest Food	45 min.
T-55	5.10	Digestive Systems Vary	135 min. (3 days)

SECTION: 5.7 Digestive Systems
Page T-55/S-154 Digestion in a Small Animal (45-50 min.)

ADVANCE PREPARATION: Materials - Draw a picture of a hydra for a worksheet on which the students will label the parts. Have a transparency/chart of the same picture.

Language Cards/Key Signs
digestion
a hydra
an amoeba
to paralyze
tentacles

Identification Cards
(Labels for pictures of hydra)

TEACHING SUGGESTIONS:

1. Begin the lesson by reviewing the section on the amoeba from Chapter 4 . Review the process of capturing and digesting food.

2. The students should read the text in section 5-7 and discuss Figure 5-15.

3. The teacher should place the chart of the hydra on the board and discuss the parts. The students can write the labels for the parts on the chart itself.

4. As a review of the lesson, the teacher can pass out the worksheets with the picture of the hydra. The students should again label the parts.

5. At the end of the lesson, the teacher should ask the students to explain the digestion process in the amoeba and the hydra.

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SECTION: 5.8 Digestive Systems
Page T-55/S-155 Large Organisms Have Digestive Systems (90 min.)

PREREQUISITES: Basic knowledge of the human digestive system.

ADVANCE PREPARATION: Materials - Make a large chart/transparency of the digestive system in Figure 5-16, do not put labels on the picture, but make label cards (if a chart is used). Make a student worksheet with a similar drawing, putting the labels for the picture at the bottom of the page. Draw several types of food on separate pieces of paper. Have several plastic cups ready for the lesson as well as vials filled with the following:
-a liquid to represent saliva
-a liquid for stomach acid
-pancreatic juices
-bile

These vials should each be labeled with their 'contents.'

Language Cards/Key Signs
the digestive system
salivary glands
the esophagus
the stomach
the intestines
the pylorus
the pancreas
the liver bile
the gall bladder
villi
the appendix
the rectum
the anus

Identification Cards
(Labels for picture of digestive system)

TEACHING SUGGESTIONS:

1. The teacher should pass out a cracker to each student. The teacher should instruct the students to chew the cracker while standing on his or her head. (They can also kneel on the floor, lean forward and touch their heads to the floor.) When the students have finished chewing the cracker, the teacher should ask the students if the cracker went 'down.'

2. The class should discuss the results of the experiment. The teacher should point out that the movement of muscles pushed the food down and that it does not matter if the person is upside down or right side up.

3. The teacher should put the chart of the digestive system on the board. The teacher should ask the students the name for each part of the digestive system. After the students respond with the correct label for the first item, the teacher should place the label on the picture. Then the teacher should follow this sequence of activities for each part of the system. When the students do not know the information, the teacher should explain the functions according to the text on pages 156-157. (NOTE: The students need not read the text.*)

4. At the end of this lesson the teacher should pass out the worksheet and the students should label the digestive system without looking at the large chart, or in their books.

* The students should however, refer to the picture on page 158 when drawing the intestines.

Day 2

1. The teacher should again put up the chart/transparency on the board. Each student should have the opportunity to label and state the function of one part of the system.

2. The teacher should put out the materials listed in the materials section

(drawings of food, plastic cups, vials of liquids). The teacher should explain to the class that they will play a game - A Digestive Game. The students should sit in a circle with the materials on a table in the center of the group, within easy reach of each member of the class.

3. The teacher should explain to the class that they are now the human digestive system. Each person represents a different organ in the system. Each organ will be required to do something to the food being passed through the system, and to state the function of that particular organ.

4. To start the game, the teacher should take one drawing of food and state that this human will eat (food). Then he/she should pass the food to the person on his or her right. That person is the mouth. The person needs to state who they are, and their function. Then the student should do whatever is necessary to the food. (In this case the student tears up the food, puts it in a cup and adds saliva, from the appropriate vial.) Each student takes a turn becoming the next part in the system.

5. The teacher should do this activity several times until the students understand the sequence of events which occur, and the organs involved in the digestive process.

****

SECTION: 5.9 Digestive Systems
Page T-55/S-158 Plants Also Digest Food (45 min.)

Language Cards/Key Signs
photosynthesis
starch

Identification Cards
(Labels for the experiment)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials and directions for the experiment. Write out the directions for the experiment on a chart/transparency.

TEACHING SUGGESTIONS:

1. The teacher should display the materials for the experiment on a table in front of the class. The students should be asked to label the materials.

2. The teacher should then display the chart explaining the experiment. The students should read the directions referring to the materials as necessary. The students should work in pairs for the experiment.

3. The teacher should pass out the materials to the students. The students should follow the directions and complete the experiment. Do not refer to the questions in the book. Focus the discussion on the differences which they see between the green and ripe bananas. Have several students draw pictures on the board of what they are seeing. Discuss the possible reasons for the differences.

4. Then read the beginning of section 5-9. Discuss the information and how it related to the experiment. At the end of the class ask several stduents to explain again the differences between a green and ripe banana.

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SECTION: 5.10 Digestive Systems
Page T-55/S-159 Digestive Systems Vary (135 min. - 3 days)

PREREQUISITES: Skills in dissection of specimens.

ADVANCE PREPARATION: Materials - Get a variety of organisms to dissect: a frog, an earthworm, a fish, and possibly a cat. These can be ordered from Carolina Biological Supply. Have all of the necessary dissecting guides for each organism used. Also, if possible, purchase a Venus Fly Trap. (This can also be ordered from Carolina.) A large sheet to tagboard for each student.

Language Cards/Key Signs
a gizzard
cellulose
bacteria
termites
fungus

Identification Cards
Labels for parts of digestive systems of animals dissected

TEACHING SUGGESTIONS:

1. The teacher should pass out the dissecting materials. The students should work in pairs. Each pair should choose which organism they want to dissect. They should work carefully, following the dissecting guide. (If no guides are available, the teacher can ask the students to work very carefully, and try and help each group with their dissection.) The teacher should instruct the students that they are to look at the digestive system of the organism.

2. When the students have located the various parts of the digestive system, they should diagram the system and label the parts. When all of the students have finished the dissection, each pair of students can explain to the rest of the class what they found. They can also show the class their drawing of the digestive system. These can be displayed in the classroom.

Day 2

1. The students should read through the text with the teacher. They should discuss the information, and discuss each Figure.

2. When discussing the section on termites, the teacher can refer the students to pages 136-137 to look at the picture of termites.

3. The students should discuss the variety of organisms and their digestive systems. The teacher should ask the students to choose one organism. The students should then go to the library or an encyclopedia and find information on the digestive system of their particular organism. Each student should make a large diagram of the digestive system and label the parts. (These will be used during the next class.)

Day 3

1. Each student should take turns giving his or her report to the class on the organism and its digestive system. The students can discuss the information after each presentation.

2. The students should read the Highlights section. The teacher should ask the students questions about the concepts in this section.

3. The students should take their own paper and answer the Checkpoints. The teacher can paraphrase the questions if necessary.

4. When the students have conpleted their answers, they should discuss them with the class.

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Level 7 Unit 2 Life Systems

Chapter 5 Digestion and Excretion

The Excretory System

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-56	5.11	The Kidneys Get Rid of Urea	50 min.
T-56	5.12	Kidneys Help Control Water Loss Also	50 min.
T-56	5.13	Excretory Systems Vary	45 min.
T-57	5.13	Field Trip	60+ min.
	5.13	Evaluation	45 min.

SECTION: 5.11 The Excretory System
Page T-56/S-163 The Kidneys Get Rid of Urea (50 min.)

PREREQUISITES: Basic information on the excretory system.

ADVANCE PREPARATION: Materials - Make a large chart/transparency of the Excretory System without the labels. Make the labels separately, which could then be placed on the drawing by the students. Make a worksheet for the students with the same picture, placing the names of the parts at the bottom of the page. Purchase several beef kidneys to be used in the class. Have dissecting tools and trays ready for the class.

Language Cards/Key Signs
a kidney
urea
to excrete
the excretory system
urine
ureters
the bladder

Identification Cards
(Labels for diagram of excretory system)

TEACHING SUGGESTIONS:

1. The teacher should begin the lesson by stating that the class has been studying the digestive system, which takes care of solid waste. The teacher should ask the class which system takes care of liquid waste, and also ask if the students remember any of the parts of the system.

2. The teacher should display the chart/transparency. The students should trace the path of liquid waste from the kidneys to the urethra. They need not use the labels at this time.

3. Then the teacher can begin to explain about the parts of the system. Starting with the kidneys, the teacher should ask the students for the name of the organ, and then ask if they know the function. If not, the teacher can explain the function, and then go on to the next part of the system. The teacher should continue until all of the organs of the system have been discussed.*

4. To review, the teacher should ask each student to explain a part of the system and to name that part. (Labels could be removed for this discussion.)

5. The teacher should display the beef kidneys. The students should work in pairs or teams, and carefully look at the structure, consistency, etc. of the kidney. They can cut into the kidney and look at the internal structures. The class can discuss what they have observed when they have finished dissecting the kidney.

6. The teacher should pass out the worksheet on the Excretory System. Without looking at the labelled chart, the students should label the parts of the system, on their paper.

*The teacher should include all information from section 5-11. The students need not read the text.

* * *

SECTION: 5.12 The Excretory System
Page T-56/S-165 Kidneys Help Control Water Loss Also (50 min.)

ADVANCE PREPARATION: Materials - Use chart from previous lesson.

Language Cards/Key Signs
to sweat

TEACHING SUGGESTIONS:

1. To review the previous lesson, place the chart of the Excretory System on the board. Ask each student to label and explain the function of one part of the system.

2. Place the labels on the board (in no particular order) and take down the chart. Ask several students to place the names of parts of the Excretory System in order beginning with the kidneys. Discuss their answers and have other students make any necessary changes in their list.

3. The teacher and students should read the text for this section. The class should discuss the information in the text as they read through it.

4. To review the information in this section, the teacher should ask the following questions: How does water leave the body? When would a person sweat and why does it happen? What ways are there for you to get water? Suppose you drink a lot of water during one day. How will your kidneys deal with the excess of water?

* * *

SECTION: 5.13 The Excretory System
Page T-56/S-166 Excretory Systems Vary (45 min.)

ADVANCE PREPARATION: Materials - If possible, contact a hospital in your area. If they have a kidney machine, ask if you could bring the students to see the machine. Also ask if a doctor or nurse could explain to the students how the machine functions.

Language Cards/Key Signs
uric acid
a donor
the artificial kidney
a transplant

TEACHING SUGGESTIONS:

Day 1

1. The teacher and students should read through section 5-13.

2. The class should discuss the differences between the excretory systems of different organisms.

3. The class should discuss the problems a person would have if their kidneys were not functioning. Then read the article Artificial and Transplanted Kidneys.

Day 2

1. If possible, visit a local hospital and allow the students to see a real kidney machine. Have a doctor or nurse explain the functioning of the machine.

Day 3

1. Review the information which the students learned on their trip to the hospital.

2. The students should read the Highlights section. The teacher should ask the students questions on each of the concepts in the Highlights.

3, The students should write the answers to the Checkpoints. After the students have finished their answers, they could discuss them with the class.

4. The students should then do the Skullduggery section. This is an excellent review of the vocabulary of this chapter.

5. At the end of the class, read through the What's Next? section to start the students thinking about the respiratory system.

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Level 7 Unit 2 Life Systems

Chapter 6 Respiratory Systems

Gases Move In and Out

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
	6.0	Introduction	40 min.
T-59	6.1	Oxygen Goes In; Carbon Dioxide Comes Out	45-50 min.
T-59	6.2	Gases Are Exchanges With Water and Air	150 min. (3 days)
T-59	6.3	Special Structures Exchange Gases	90 min. (2 days)
T-60	6.4	Many Land Animals Breathe	90 min. (2 days)
		Highlights and Checkpoints	40 min.

SECTION: 6.0 Gases Move In and Out
Page S-170-71 Introduction (40 min.)

TEACHING SUGGESTIONS:

Language Cards/Key Signs
the underwater world
a diver
an air tank

1. This introduction should be used to pose a problem. The teacher should ask the students to look at the pictures on pages 170-171. The class should discuss what is in the picture.

2. The teacher can ask, How is it possible to live underwater? The students should describe the necessary components of underwater life.

3. The class should then read the text in the introduction. The students can discuss the information in the text and compare it to their previous discussion.

* * *

SECTION: 6.1 Gases Move In and Out
Page T-59/S-172 Oxygen Goes In; Carbon Dioxide Comes Out (45-60 min.)

PREREQUISITES: Familiarity with the terms oxygen and carbon dioxide.

TEACHING SUGGESTIONS:

Language Cards/Key Signs
gas exchange
oxygen
carbon dioxide
an astronaut

1. Again the teacher should pose a problem. The problem is, How can a person live on the moon? The class should discuss the necessary components of life on the moon. They should refer to the picture during this discussion.

2. The students and teacher should read the text in section 6-1. The teacher should emphasize the concept of gas exchange, and ask several students to explain the term. The students should use the vocabulary words oxygen and carbon dioxide during the discussion.

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SECTION: 6.1 Gases Move In and Out
Page T-59/S-173 Gases Are Exchanged With Water and Air (150 min. - 3 days)

ADVANCE PREPARATION: Materials - The teacher should have an aquarium with fish set up, a glass of warm water and a glass of 7-up. Also the teacher should make cut out cells (about 2" in diameter) making enough so that each student has 50 cells. The teacher should also make a drawing of the internal and external structures of the earthworm. (The encyclopedia is a good source for a picture to copy.) The teacher should also make a transparency of Figure 6-2.

Language Cards/Key Signs
to dissolve
a molecule
diffusion
an earthworm

TEACHING SUGGESTIONS:

Day 1

1. The teacher should place the aquarium, glass of water and glass of 7-up on a table in front of the class. The teacher should tell the students that they will be observing some liquids. As the students are observing the different objects, the teacher should ask questions about them.

2. As the students observe the aquarium, the teacher should ask if fish need oxygen to live. The students should discuss the needs of the fish and how they think the fish gets oxygen from the water.

3. The teacher should ask if the students think that air could be dissolved in water. The class should discuss the possibility. Then the teacher should have the students observe the glasses of liquid.

4. The students shuuld be able to see the air bubbles in both of the liquids. The class should discuss their observations.

5. Then the class should read the text of section 6-2 on page 173.

6. The students should discuss the information in the text, and the teacher should again question the students. The teacher should ask if air can be dissolved in water. The teacher should also ask how fish get oxygen from water.

Day 2

1. The lesson should begin with the teacher showing the transparency of Figure 6-2. The teacher should pose the question as stated in the text (Figure 6-2).

2. The class should then read the first paragraph on page 174 and discuss the information about diffusion.

3. The teacher should read (paraphrase) the next paragraph with the class. The teacher should explain the problem of this many-celled organism. The class should discuss the problems of this organism in getting enough oxygen.

4. Then the teacher should pass out the cell cut-outs. The teacher should instruct the students to work in pairs and to invent different kinds of many-celled organisms. The teacher should add that their organisms should be able to exchange oxygen/carbon dioxide with the surrounding water. (At this point do not let the students refer to page 175.)

5. After each pair has developed one or two possible organisms, they should be shown to the class and discussed. The students should discuss any possible problems with the arrangements shown by the students.

6. The students should then read the remainder of the text on page 174-175. The Figure 6-3 should also be discussed. As the students are discussing the figure, they should refer to their own invented organisms and compare the two sets of invented organisms.

Day 3

1. A drawing or transparency of the internal-external structures of the earthworm should be displayed at the beginning of class. The teacher should explain the basic structures of the earthworm.

2. Then the teacher should state that the earthworm is made of many cells. The teacher should ask the class how the cells of the earthworm get oxygen. The possibilities should be discussed.

3. Then the students should read through the text and answer the questions posed previously by the teacher.

4. At the end of the class the teacher should again ask the students how the earthworm gets oxygen to every cell. Any interested could take their cell cards and set up an arrangement of cells comparable to the earthworm.

****

SECTION: 6.3 Gases Move In and Out
Page T-59/S-176 Special Structures Exchange Gases (90 min. - 2 days)

ADVANCE PREPARATION: Materials - see Advance Prep. in Teacher's Manual for fish experiment. The teacher should also make a drawing of the imaginary animal in Figure 6-5 without the blood vessels. Collect pictures of other organisms with gills. Make copies of Figure 6-7, one for each student. The teacher should write out directions for the experiment, on chart paper or transparency.

Language Cards/Key Signs
gills
respiratory system

Identification Cards
(Labels for experiment materials)

TEACHING SUGGESTIONS:

Day 1

1. The first activity will be the experiment on page 179. The teacher should display the materials for the experiment. The students should label the equipment.

2. The students should read the directions for the experiment which the teacher has posted on the board.

3. The students, as a group, should perform the experiment. Each student should record the data on their data sheet which the teacher has passed out. While the experiment is being conducted, several students could be designated as counters and several others could be writing down the information.

4. The students' observations should be discussed as they occur. At the end of the experiment, the students should discuss the results and possible reasons for them. The questions at the end of this section should be answered by the students.

Day 2

1. The teacher should show the students the imaginary animal drawing from Figure 6-5. The teacher should pose the problem that this is an imaginary animal. How could oxygen get to each cell of this animal. The students should give possibilities and using a red pen, draw the possibilities on the drawing.

2. The students should then turn to page 176 and read the text that discussed the gill system. The students should compare their ideas with the information in the text.

3. The teacher should show the students the pictures of other organisms that have gills. The students should discuss these organisms and their respiratory systems.

4. At the end of the class, the students should take the pictures and begin a bulletin board of Respiratory Systems. The teacher or students can make the title for the board - RESPIRATORY SYSTEMS.

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SECTION: 6.4 Gases Move In and Out
Page T-60/S-180 Many Land Animals Breathe (90 min. - 2 days)

ADVANCE PREPARATION: Materials - Order a bullfrog from a biological supply. Also have all necessary dissecting equipment on hand. Make a drawing of the frog showing the respiratory system (transparency or chart). Dissecting a frog as a demonstration would be more practical because frogs are very expensive for all the use you would get from observation of just the respiratory system. A team of students could do the demonstration. Use of a live frog and an aquarium could add a great deal as an observation.

Language Cards/Key Signs
the trachae
to breathe
an air sac
the lungs
an insect
an amphibian

TEACHING SUGGESTIONS:

1. Have your students make observations of a live frog in an aquarium. Notice behavior while floating: position of eyes, nostrils, movement of chin, etc. Force the frog under water. Now record data on changes that occur: eyes (nictating membrane), nostrils, chin and stomach. How long does the frog stay underwater? What relationship is there between the frog's chin and his nostrils?

2. Have frog dissecting demonstration: The students should be instructed to use their dissecting skills to carefully open up the chest of the frog. The students are looking for the respiratory system. The students should work on the dissection until they have found the lungs. They should then look for other structures that connect to the lungs.

3. The class should discuss the overall structure of the frog's respiratory system. The students should refer to the chart of the frog which the teacher can display on the board.

Day 2

1. The students and teacher should read through the text on pages 180-182. The students should discuss the structures involved in the respiratory systems of these animals.

2. When the students have finished reading the text, the teacher could ask for volunteers to copy the various pictures of organisms in this section. The students should be asked to copy the pictures and draw in the respiratory systems. These can then be displayed on the bulletin board.

****

SECTION: 6.4 Gases Move In and Out
Page S-183 Evaluation (40 min.)

TEACHING SUGGESTIONS:

1. The class should read the Highlights section. The teacher should ask the students questions about each conept covered in the section of this chapter.

2. For the Checkpoints, the teacher should read/paraphrase the questions. The students should write their answers on paper.

3. When the students have completed their answers, they should discuss them as a group.

****

Level 7 Unit 2 Life Systems

Chapter 6 Respiratory Systems

The Human Respiratory System

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-60	6.5	Air Moves Into and Out of The Lungs	100 min. (2 days)
T-61	6.6	Breathing Is Automatic	40 min.
T-61	6.7	Your Respiratory System Does More Than Breathe	135 min. (3 days)
T-62	6.8	Plants Have Structures for Gas Exchange	90 min. (2 days)

SECTION: 6-5 Air Moves Into and Out of the Lungs
Page T-60/S-183 The Human Respiratory System (100 min. - 2 days)

PREREQUISITES: Ability to label the major parts of the respiratory system. Ability to measure the volume of water in a jar and to do subtraction and addition.

ADVANCE PREPARATION: Materials - Prepare the materials for the experiment as listed in the Teacher's Manual. Also follow the directions (see attached paper) for construction of a model of the lungs. Make a large chart or transparency of Figure 6-11. Also make a ditto of this same drawing at the bottom of the page. Rewrite the directions for the experiment. Put them on chart paper/transparency.

Language Cards/Key Signs
the epiglottis
the trachea
the larynx
the vocal cords
bronchi
bronchioles
air sacs
the diaphragm

Identification Cards
(Labels for material in the experiment)

TEACHING SUGGESTIONS:

Day 1

1. The teacher should display the chart explaining the experiment on pages 187-188. The teacher should also display the materials necessary for this experiment.

2. The students should label the materials for the experiment. They should also read the directions for the experiment. The teacher should make sure that the students understand what will be done during the experiment. The students should refer to Figure 6-14 during the discussion.

SECTION: 6-6 The Human Respiratory System
Page T-61/S-189 (Breathing is Automatic (40 min.)

ADVANCE PREPARATION: Materials - Make a ditto with the following chart. Have a stopwatch or clock in the classroom.

Language Cards/Key Signs
automatic
to faint

	At rest	After exercise
Numbers of breaths in one minute		

TEACHING SUGGESTIONS:

1. The teacher should ask the students if they know how many times they breathe in one minute. The guesses should be put on the board.

2. Then the teacher should ask the students what would happen to their rate of breathing if they ran for one minute and then counted the breaths. Again the guesses should be written on the board.

3. The teacher should then pass out the chart. The students should count how many times they breathe in one minute. The teacher should be the time keeper. This number should be recorded on their charts.

4. Then the teacher should ask the class to run in place for one minute. When the minute is over, the students should sit down and again start counting the number of breaths while the teacher times one minute.

5. The class should discuss the results of the experiment.

6. Then the class should read section 6-6. The teacher should make sure that the students understand the term automatic. The teacher should give the students situations, and ask what would happen to their breathing. The teacher could say- Suppose you are sleeping. Does your breathing continue?

7. The teacher should end the lesson by asking the students what other changes take place in the body during exercise. The teacher should remind the students that they will be studying about the Circulatory System in the next chapter.

****

SECTION: 6-7 The Human Respiratory System
Page T-61/S-189 Your Respiratory System Does More Than Breathe (135 min. - 3 days)

ADVANCE PREPARATION: Materials - Ask someone skilled in CPR to visit the class, to teach the students the Heimlich Maneuver.

Language Cards/Key Signs
mucus
to cough
an aqualung
a skin diver
research
resources

TEACHING SUGGESTIONS:

Day 1

1. Begin the class by reading section 6-7. The teacher should read the text to the

3. The students should copy the chart from Figure 6-15.

4. After the students have copied the chart, they should work in pairs and set up the experiment. The teacher should circulate among the students to check and see if they have done the set up correctly.

5. As the students begin the measurement part of the experiment, the teacher should stop the students and review the directions. (This is a difficult part of the experiment. The students should understand exactly what they must do.) After the students have completed their calculations, they should write the results on the chart.

6. The class should discuss the results of the experiment. Students should compare their lung capacity, for a normal breath and deep breath and also compare lung capacity among the students.

Day 2

1. The teacher should display the chart on the respiratory system in front of the class. The students and teacher should read through the information in this section beginning on page 183.

2. As the students read about a particular part of the system, they should refer to it on the chart.

3. The students should also read the information under Figure 6-12. As they read about the vocal cords, they should make sounds and feel their own vibrations.

4. When the students are reading about the action of the diaphragm, the teacher should display the model of the lungs. As the students read and discuss the diaphragm, the teacher should show the students how the diaphragm works on the model. Several students should be asked to move the diaphragm on the model and show what happens to the lungs.

5. During the discussion, the students should breathe and feel the movement of the diaphragm, and the position of the rib cage with inhaling and exhaling air.

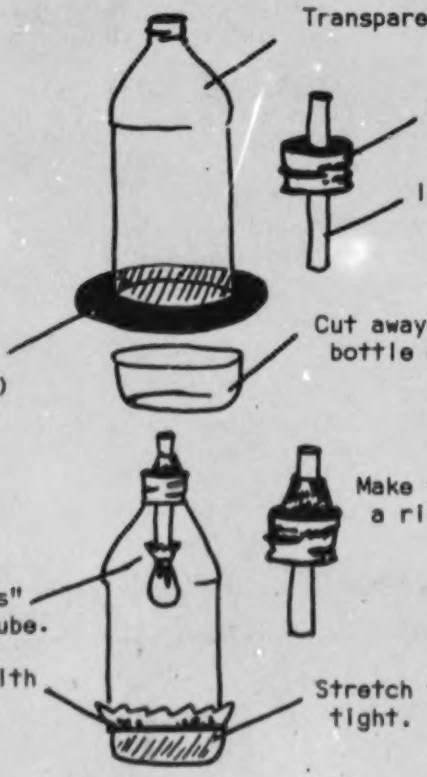
6. At the end of the class the teacher should pass out the ditto of the respiratory system. The students are to label the parts of the system in the diagram.

****

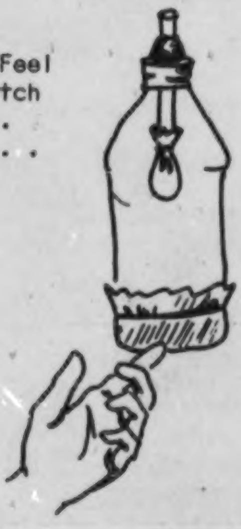
MODEL LUNG

You can make a working model of the lungs with a transparent glass or plastic bottle and a balloon lung. Press the diaphragm and the lungs will exhale.

(1) You can construct a simple lung with materials found at home.


Transparent glass or plastic bottle
Punch a hole in the lid.
Insert plastic straw.
Rubber sheet (a cut open balloon)
Cut away bottom with scissors or a bottle cutter.
Make the straw air-tight with a ring of clay or wax.
Tie the balloon "lungs" to the "wind pipe" tube.
Attach the balloon with a rubber band.
Stretch the balloon "diaphragm" tight.

(2) Push the diaphragm. Feel the air rush out. Watch the lungs contract ... relax ... contract .... .



(3) Now check your own diaphragm. How is it going? Why can't you exhale when you close your nose and mouth?

students. The students should discuss their experiments with breathing, and noticing what the nose does. The teacher should ask the students to describe how it feels to have a cold, with the nose clogged with mucus, and how breathing feels during this time.

2. The teacher should find someone in the school (or be trained him or herself) to come to the class and first discuss, then demonstrate and third instruct the students in the Heimlich Maneuver.

3. The class should discuss why this is effective when someone is choking on food. The class should also discuss why people choke on food and how to prevent it.

4. At the end of the class the teacher should review the entire respiratory system, discussing the position and function of each organ of the system.

Day 2

1. During this lesson, the students should read the story about Jacques Cousteau. They should discuss the development of the aqualung and the work that Cousteau has done. The teacher should emphasize the necessity of preserving the natural resources of the oceans.

Day 3

1. The students should read the Highlights section. The teacher should question the students on the concepts discussed in these sections.

2. The students should write the answers for Checkpoints. The teacher should paraphrase the questions for the students.

3. After the students have completed the questions, they should discuss their answers.

****

SECTION: 6-8 The Human Respiratory System
Page T- 62/S-191 Plants Have Structures for Gas Exchange (90 min. -2 days)

ADVANCE PREPARATION: Materials - For the experiment listed in this section, do not use the nail polish. Instead have the students make slides of the plant tissue. Use a begonia leaf if possible. It is easier to peel off the bottom layer from this type of leaf. Write the directions for the experiment on chart paper. The students can use dissecting equipment (scapel, tweezers, etc.) for making the slides. It is not necessary to stain the plant cells. The other materials, as listed in the Teacher's Manual remain the same. Make a large drawing/transparency of the internal structure of a leaf. Make separate labels that students could put on the drawing during the lesson. Also make a ditto of the same picture.

Language Cards/Key Signs
respiration
photosynthesis
the epidermis
guard cells
a stomate
chloroplasts
tightly packed cells
loosely packed cells

Identification Cards
waxy coating
upper epidermis
tightly packed cells
loosely packed cells
lower epidermis
guard cells
stomates
(Labels for drawing)

TEACHING SUGGESTIONS:

1. The teacher should display the materials for the experiment (with modifications) from page 194. The chart with directions for the experiment should also be on display on the board.

2. The class should read the experiments, and discuss the materials, labeling them as they read through the experiment.

3. The teacher should caution the students to take care in preparing the slides. The students should work in pairs. The teacher could pass out the materials, and then help the students get started with making their slides.

4. After the slides have been made, the students should look at them under the microscope. Drawings of what the students see can be made and displayed during the class discussion. When the students have completed their drawings, they should compare them and discuss the structures which they observed.

5. At the end of the class the students should look at page 193 and compare the drawings of the stomates with what they saw under the microscope.

Day 2

1. The teacher can begin the lesson by reviewing the observations of the previous lesson.

2. The students and the teacher should read through the information in section 6-8.

3. As the class reads about the structure of the leaf, the teacher should display the drawing of the leaf. When the class has completed the text, the teacher should ask the students to label the drawing. The teacher can also ask the students to explain the functions of the different parts, and explain how the process of photosynthesis works within the leaf structure.

4. When the students have completed the discussion, the teacher should pass out the worksheets with the drawing of the leaf structure. Without looking in the book or at the labeled drawing on the board, the students should label their picture of the leaf. Then they can check their answers by looking in the text.

5. The students should read the Highlights section. The teacher should ask the students questions about the concepts in this section.

6. The students should complete the Checkpoints section. When they have written their answers, they should discuss them with the group.

7. NOTE: Omit the Skullduggery section. At the end of the class, the teacher should read What's Next? section to the students.

****

The Importance of Transport

A. SECTION OUTLINE

Page	Section Number	Lesson Title	Teaching Time Suggested
T-64	7-1	What is a Circulatory System	45-50 min.
T-65	7-2	(omit)	
T-65	7-3	(omit)	
T-65		Evaluation (omit)	

NOTE: Introduction, and sections 7-1, 7-2 and Evaluation have been omitted.

SECTION: 7-1 The Importance of Transport
Page T-64/S-198 What is a Circutatory System? (45-50 min.)

ADVANCE PREPARATION: Materials - Use the individual cut-out cells used in section 6-2. You will also need a large sheet of white construction paper, tape and a red marker. Find an already prepared transparency of the circulatory system or make your own, or make a chart of the system.

Language Cards/Key Signs
oxygen
waste
blood
the heart
the circulatory system

TEACHING SUGGESTIONS:

1. NOTE: The information in this section is presented in the form of a problem for the students to solve.

2. The teacher should place one cut-out cell on the board. Then the teacher asks the students what things are necessary for the life of the cell. The students should mention food, and oxygen.

3. Then the teacher tapes a piece of white paper to the board and places other cell cut-outs on the paper in the food, and oxygen. Then the teacher asks the students how an organism with this cell structure would get food and oxygen to each cell. The students should develop the idea that there needs to be a way to transport the food and oxygen from cell to cell.

4. Then the teacher asks the students if their bodies are made of cells. After the students respond, the teacher asks how our cells get food and oxygen. The students should mention something about the circulatory system, even if they do not know the proper vocabulary. Using the red marker, a student could draw a possible transport system on the paper with the cell arrangement.

5. The teacher then displays the chart/transparency on the board. The label The Circulatory System is written on the chart/transparency.

6. The students read section 7-1. As the section is read, the students should refer to the drawing of the system.

7. At the end of the class the teacher should discuss the overall system with the students, pointing out the heart, and blood vessels. The students can be told that they will study the system in detail, as the chapter progresses.

****

Level 7 Unit 2 Life Systems

Chapter 7 Transport Systems

The Human Circulatory System

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-66	7.6	The Heartbeat Rate Changes Automatically	150 min. (3 days)
T-66	7.5	The Heart Pumps the Blood	90 min. (2 days)
T-66	7.4	You Have Two Circulation Pathways	50 min.
T-67	7.7	Blood Moves Through the Blood Vessels	50 min.
		Evaluation	45 min.
	NOTE: The order of the sections has been changed.		

SECTION: 7.6 The Human Circulatory System
Page T-66/S-205 The Heartbeat Rate Changes Automatically (150 min. - 3 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials for experiment. In addition, see attached for Matchstick Pulse Meter, and the Tennis Ball Squeeze. Write the directions for each of the experiments on chart paper/transparency.

Language Cards/Key Signs
pulse
the wrist
exercise
a heartbeat
rate

Identification Cards
Labels for all materials in experiments

TEACHING SUGGESTIONS:

Day 1

1. At the beginning of the class, the teacher asks the students if they know what a pulse is. After the students have answered, the teacher explains that the pulse is an indication of the beating of the heart. The teacher can show the places that the pulse can be taken on the body - wrist, side of windpipe, etc.

2. The teacher then places the materials for the Matchstick Pulse Meter on a table in front of the students. The directions for the experiment should also be displayed.

3. The students read the directions for the experiment, referring to the materials as they occur in the directions. Then the teacher passes out the materials to each student and they do the experiment.

4. When the students have set up the matchstick properly, have them count the number of beats in one minute. The students should write down the number of beats. This should be done several times until the students are accurate in counting the number of beats.

5. The students could keep the pulse meter and try it out on their friends or family.

Day 2

1. The teacher displays the materials for the experiment on page 206. The students label each of the materials. The directions for the experiment are also displayed on the board.

2. The students read the directions for the experiment. The students should look at page 207 and the information which they must record. The students should copy the worksheets. The teacher should make sure that the students understand the worksheets. NOTE: The students should count their heartbeat for one minute not for 15 seconds and then multiply by 4 - this could confuse the students.

3. The students get into pairs and begin the experiment. The teacher moves among the students to make sure they understand the directions.

4. When the students have completed their worksheets, the sheets should be posted on the board. The results should be discussed. The students should note similarities and differences among the class members.

Day 3

1. The teacher should review the experiment from the previous day. The students should again discuss the results and the differences between the students.

2. The students should read the second, third, and fourth paragraphs (column 1) on page 206 and discuss the information.

3, The students should be reminded that in Chapter 5, on muscles, they had discussed the hard work of the heart muscle.

4. Display the tennis ball and the directions for the experiment. The students should read the directions for the experiment, and then take turns with the tennis ball.

5. The students using the tennis ball, should try and copy their heartbeat rate for a few minutes. The class should discuss how they feel after this exercise.

6. To give the students additional information, the teacher could ask the students how many times the heart would beat in one hour, one day, one week, or one year.

7. Fill in data on pulse during various activities (slowing of the heart - Brady cardia) will occur in many mammals. The H_2O is the stimulus not the temperature of H_2O. Count pulse immediately when face is immersed.

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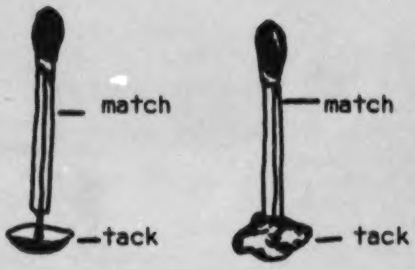
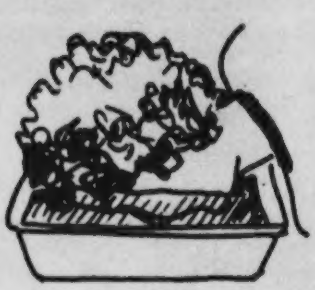
MAKING A METER FOR YOUR PULSE



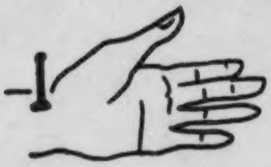
A small piece of clay or a thumbtack stuck on a match can be used to show a visual display of your pulse.

(1) Roll a piece of clay about the size of a dime or use a thumbtack. Attach the match to the tack or clay to complete construction.

(2) By placing the meter on your wrist and moving it around until you find the strongest beat, you can visually monitor pulse. (How can you increase or decrease pulse rate?)



Face in H_2O - 15 seconds

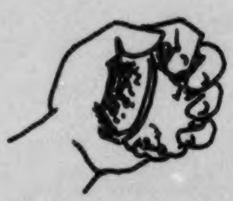


Pulse Rate Per Minute During Various Activities

	Normal	Holding Breath (hold an AVERAGE breath 15 sec. x 4)	Holding Breath with face in H_2O 15 sec. (count while in H_2O)	After Exercise (Run in place 1 minute)
Trial 1				
2				
3				
Total				
Average				
Class Average				

THE HEART: AN EXTORTIONARY MUSCLE

You can get an idea of the unusual ability of the heart muscle by doing its work with your hand.



(1) The force needed to squeeze a tennis ball is similar to the force needed to squeeze blood out of the heart.

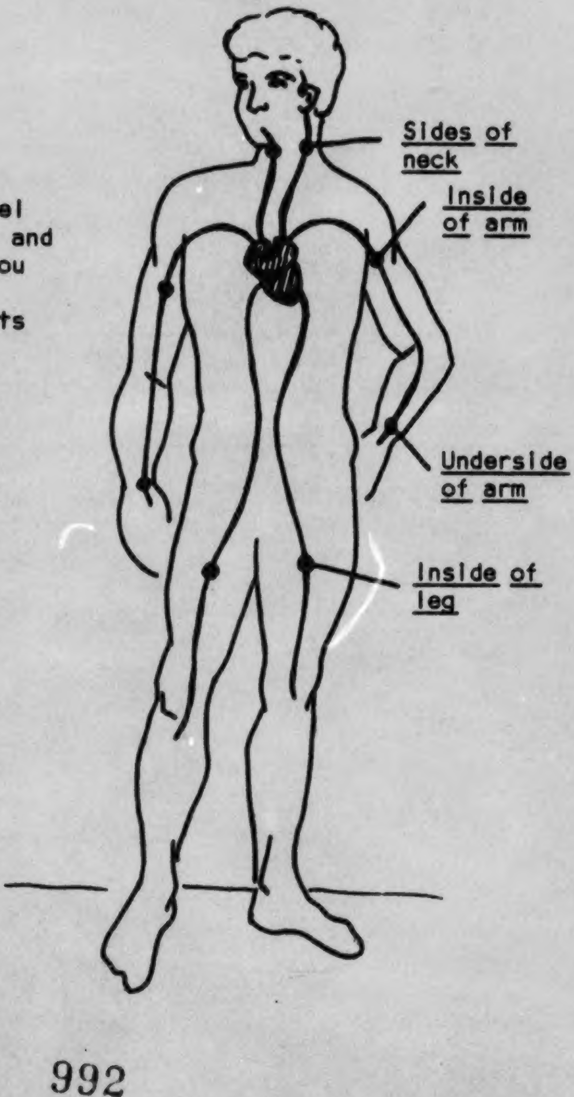
(2) If you squeeze to X a minute (the normal pulse), you will get a first hand idea of how hard your heart works.

PULSE

You can listen to heartbeat, but you have to feel a pulse. The pulse is caused by blood stopping and starting as it rushes through your arteries. You can actually feel the elastic walls of the arteries stretching and relaxing as blood squirts by.

Arteries are generally positioned far below the skin for protection. If your aorta were suddenly cut, blood would spurt six feet into the air. Stopping such a high pressure flow is difficult, at best.

Arteries surface at a few places on the body. Such spots are called pulse points. These are few and far between. Check the chart against your own.



SECTION: 7.5 The Human Circulatory System
Page T-66/S-203 The Heart Pumps the Blood (90 min. - 2 days)

Language Cards/Key Signs
chambers
atrium
ventricle
to contract
to relax
a valve
Identification Cards
Labels for the heart diagram on page 204

ADVANCE PREPARATION: Materials - See attached sheet for materials for heart dissection. Make a large chart/ transparency of the heart and a ditto for students. Make labels to accompany the drawing. If possible have a model of the heart in the class. Directions for the design of the walk through are on the back. Write the directions for the experiment on chart/ transparency. NOTE: Information about the heart and its functioning can be obtained, free of charge, from your local chapter of the American Heart Association.

TEACHING SUGGESTIONS:

Day 1

1. The teacher tells the students that they will be studying about the heart in more detail. Materials for the dissection should be displayed in front of the class.

2. The directions for the dissection should be placed on the board. The students read the directions and discuss how they will do the dissection.

3. The students begin the dissection with help from the teacher. As the students work, in pairs or teams, the teacher should circulate among them to help where necessary. When the students have cut open the heart, they should make a drawing of it.

4. After the students have completed their dissection and drawing, the teacher should display the chart showing the parts of the heart. The students should compare the drawing to the sheep heart.

Day 2

1. The students and teacher should read through the text in this section. The teacher should emphasize each new vocabulary word as it occurs. During the discussion, the drawing of the heart should be displayed on the board.

2. After the students have read the material and looked at Figure 7-5, they should close their books and try and label the large drawing of the heart. The teacher should help where necessary.

3. The walk through of the heart should be placed on the floor. First, one student at a time could choose a part of the heart, stand in it and name the part.

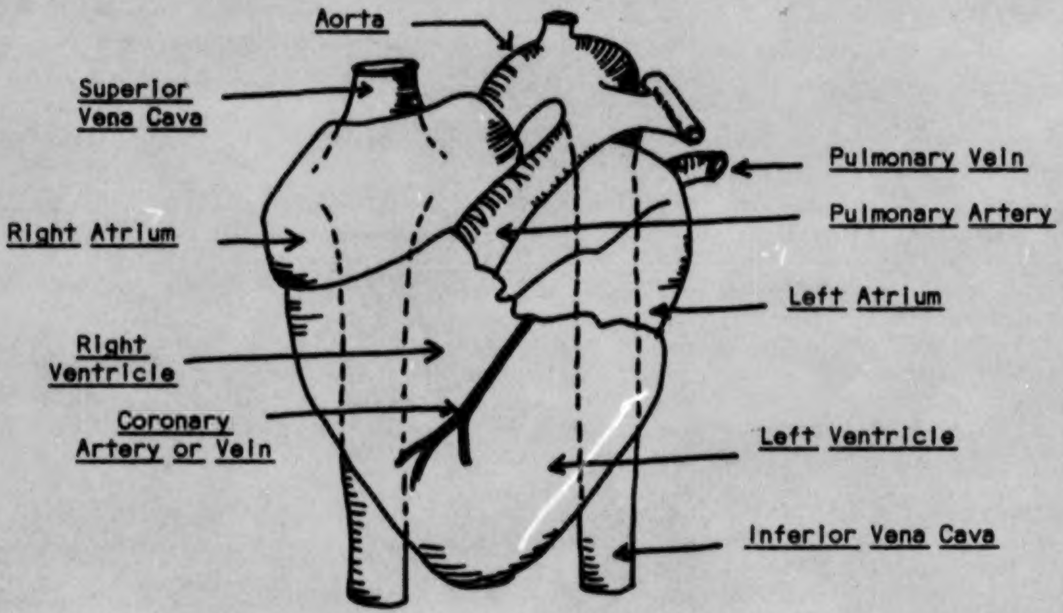
4. Then the students should show the flow of the blood by walking through the heart in the appropriate way. As the students move through the different parts of the heart, they should name the part and discuss the function of that part.

5. To combine the study of the repiratory and circulatory systems, during the walk through, a student could carry CO_2cards which are carried to the lung and then dropped off. At the same time cards would be placed in the lungs of O_2 for the student to bring back to the heart.

HEART DISSECTION

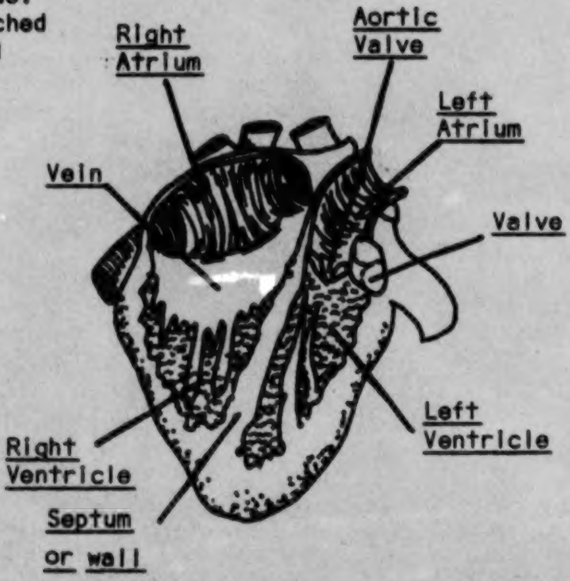
You can get a good look at the inside parts of the heart by dissecting one. A lamb heart is a good subject because it is similar in size and shape to the human model. Meat markets tend to trim all the connecting veins and arteries away. Pick one that is intact. Look for one that isn't split open.

(1) Find the front of the heart. Try to identify the main blood vessels.


Aorta
Superior Vena Cava
Pulmonary Vein
Pulmonary Artery
Right Atrium
Left Atrium
Right Ventricle
Coronary Artery or Vein
Left Ventricle
Inferior Vena Cava

(2) Slice the heart in half to see the inside. Cut slowly. Notice how things are attached before you cut them. A cleaner cut will be possible with a longer knife.

See if you can find the four chambers, the valves, and the main arteries and veins.


Right Atrium
Aortic Valve
Left Atrium
Vein
Valve
Left Ventricle
Right Ventricle
Septum or wall

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6. At the end of the class the teacher should pass out the worksheet. The students should be asked to label the parts of the heart and to show the path of blood through the heart by drawing arrows.

The Heart Walk Through

On a white sheet, draw the heart as in Figure 7-5, including the lungs. Use different colors of pens, either light/dark red, or red and blue. Do not label the diagram. Make the diagram large enough so a student could stand in any chamber of the heart.

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SECTION: 7.4 The Human Circulatory System
Page T-66/S-201 You Have Two Circulation Pathways (50 min.)

ADVANCE PREPARATION: Materials - Make both a large chart for the board with labels and a walk through of the entire circulatory system. The walk through should be put on a sheet, and large enough so that a student can actually walk over the system. Cards with CO_2 and O_2 should also be used. Also make a ditto of the system for the students to label.

Language Cards/Key Signs
blood vessels
vena cava
pulmonary artery
pulmonary vein
aorta

Identification Cards
Labels for the diagram of the circulatory system

TEACHING SUGGESTIONS:

1. The walk through should be placed on the floor. The students should discuss the path of blood in the entire system. Several students could demonstrate the path of blood in the body.

2. The students should then read the information in this section. The teacher should display the large drawing of the system on the board. As a part of the system is discussed, it should be pointed out on the diagram.

3. After the students have completed reading the text, they should label the large diagram.

4. The students should go back to the walk through and do it again. However, this time, students should name the parts as they pass through them. After they have correctly named the parts, the cards for oxygen and carbon dioxide should be used.

5. Several students could demonstrate how oxygen and carbon dioxide are carried by the blood.

6. At the end of the class, pass out the ditto worksheet. The students should label the diagram (labels could be placed at the bottom of the paper) and discuss their answers.

****

SECTION: 7.7 The Human Circulatory System
Page T-67/S-208 Blood Moves Through the Blood Vessels (50 min.)

Language Cards/Key Signs
an artery
a vein
a capillary
a valve

Identification Cards
Labels for diagram of vein

ADVANCE PREPARATION: Materials - Ask the nurse to come to class and take everyone's blood pressure. For the Under Your Tongue experiment, see attached sheet. Make a ditto from Figure 7-12. Write the labels at the bottom of the page.

TEACHING SUGGESTIONS:

Day 1

1. The teacher should ask the school nurse to come to the class. First the nurse should explain the procedures for taking blood pressure. The teacher should explain the relationship of blood pressure to the heart.

2. Then the nurse takes the blood pressure of each student. The teacher records the numbers. When the nurse has finished, the students discuss the results and compare the blood pressure of individuals in the class.

3. The students then read the text in this section. They should refer to the figures when appropriate. When discussing the veins and arteries, the students can do the Under Your Tongue experiment. The students should discuss what they have observed.

4. At the end of class the teacher passes out the ditto on the vein. The students label the diagram and discuss their answers.

Day 2

1. The students read the Highlights section. The teacher asks the students questions about the concepts covered in this section.

2. The students answer the Checkpoints questions. The teacher can reword the questions if necessary.

3. When the students have completed their work, they can discuss their answers.

4. All of the charts and materials used in this section could be placed on display in the classroom.

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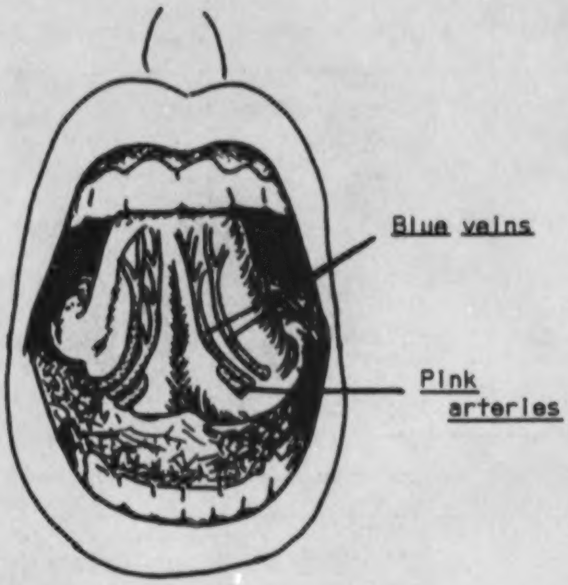
OBSERVATIONS OF BLOOD VESSELS

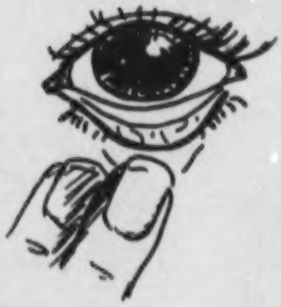
A good place to observe living blood vessels first hand is under your tongue.

(1) You will need a mirror, a strong light, a magnifying glass, and a tongue. Look at the underside of your tongue.

(2) Color and size will help you identify the kinds of vessels.
Thick Blue lines = veins
Thick Pink lines = arteries
Tiny Hair-Thin lines = capillaries



(3) To observe capillaries, pull down the fold under the eye.



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Chapter 7 Transport Systems

Blood and Its Functions

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
		Dr. Charles Drew and Blood Banking	45 min.
T-68	7.8	Blood Is About Half Plasma	90 min. (2 days)
T-68	7.9	The Plasma Carries Blood Cells	90 min. (2 days)
T-68	7.11	People Have Different Blood Types	90 min. (2 days)
T-68	7.10	The Lymphatic System Is Another Transport System	50 min.
		Evaluation	45 min.

NOTE: The order of the sections has been changed.

SECTION: 7.8 Blood and Its Functions
Page T-68/S-210 Blood Is About Half Plasma (90 min. - 2 days)

PREREQUISITES: Basic knowledge of the components of blood.

ADVANCE PREPARATION: Materials - Locate a blood bank in your area which permits visitors. Set up a field trip to the center.

Language Cards/Key Signs
a Blood Bank
a transfusion
plasma
a blood cot

TEACHING SUGGESTIONS:

Day 1

1. The teacher begins the lesson by writing the words Blood Bank on the board. The students discuss what this term could mean.
2. The teacher explains what a blood bank is and why it is necessary.
3. The teacher reads the story about Dr. Drew, page 217, to the class. The teacher should explain any terms which are unfamiliar to the students.
4. At the end of the lesson, the teacher tells the students that they will visit a blood bank on the following day.

Day 2

1. The teacher should take the students to visit a blood bank. While at the blood bank, the teacher should have the technicians show the students the bags of blood, the things used in separating the blood, and possibly a sample of blood with the plasma separated. If possible, also have the students look at a blood sample under the microscope.

2. After returning to the school, discuss what the students have seen during the trip.

Day 3

1. The students should read section 7-8. The information in this section should be discussed in relation to the observations made by the students on the trip.

2. The teacher should emphasize the information in Figure 7-13 and 7-14 by explaining each picture. The class should discuss the need for a clotting mechanism in the blood.

3. For additional information, the teacher can explain the hereditary illness of hemophilia.

4. At the end of the class, the teacher should review any new vocabulary, and ask the students to explain how blood clots.

****

SECTION: 7.9 Blood and Its Functions
Page T-68/S-211 The Plasma Carries Blood Cells (90 min. - 2 days)

PREREQUISITES: To name the components of blood (red cell, white cell, plasma, platelets).

ADVANCE PREPARATION: Materials - Buy a large bone from a meat market and have the butcher saw the bone in half lengthwise. Have prepared slides ready showing blood cells. (You could do a slide of your own blood.) Send home a permission slip (for section 7-11) asking if the students can prick their fingers to get blood samples.

Language Cards/Key Signs
red blood cells
hemoglobin
a capillary
bone marrow
white blood cells
a bacterium cell
antibodies
platelets

TEACHING SUGGESTIONS:

Day 1

1. The prepared slides should be set up with microscopes. The students should go to each microscope and look at each slide.

2. After the students have seen each slide, the class should discuss what they saw. The students should compare the blood cells on the different slides.

3. The students should begin to read section 7-9 from page 211 to the bottom of page 212. (White cells will be discussed in the next lesson.)

4. As the students discuss the production of red cells, display the bone which has

been cut in two. The teacher should show the students where red cells are produced.

Day 2

1. The students should continue to read section 7-9, discussing white cells and their function in the body. The teacher should emphasize the necessity of white cells, and question the students about what would happen if there were not white cells in the body.

2. The students should read the last paragraph on platelets. The teacher should ask several students to explain the function of platelets. The students should again refer to Figure 7-14 and discuss the clotting of blood.

3. For further discussion, the teacher can ask the students what would happen if the blood had too many platelets.

4. To end the lesson, review the components of blood and their functions.

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SECTION: 7.11 Blood and Its Function
Page T-68/S-214 People Have Different Blood Types (90 min. - 2 days)

ADVANCE PREPARATION: Materials - If possible, purchase a blood typing kit from a Biological Supply. The kits are not expensive. The kit contains the chemicals necessary to type blood. Be sure that the students have permission from their parents before doing the typing. Have the school nurse in the class when the blood typing is being done. Have glass slides and microscopes ready for the class. Make copies of the blood type chart (see attached sheet).

Language Cards/Key Signs
blood types
a blood transfusion
blood protein

TEACHING SUGGESTIONS:

Day 1

1. The teacher explains to the students that there are different types of blood. The teacher also explains that they will be finding out what blood type each person is.

2. The school nurse should explain the procedures for finding out the blood types. The nurse can then prick the students' fingers and the students can perform the test. In addition to the type testing, each student should make a slide of their blood.

3. When all of the students have completed the testing, they should look at their blood slide under the microscope, as well as looking at other students' slides.

4. Then the students should compare the results of their typing test. Without labeling the types, the students should group samples together that they think look the same from the test. These should be saved for the next day's lesson.

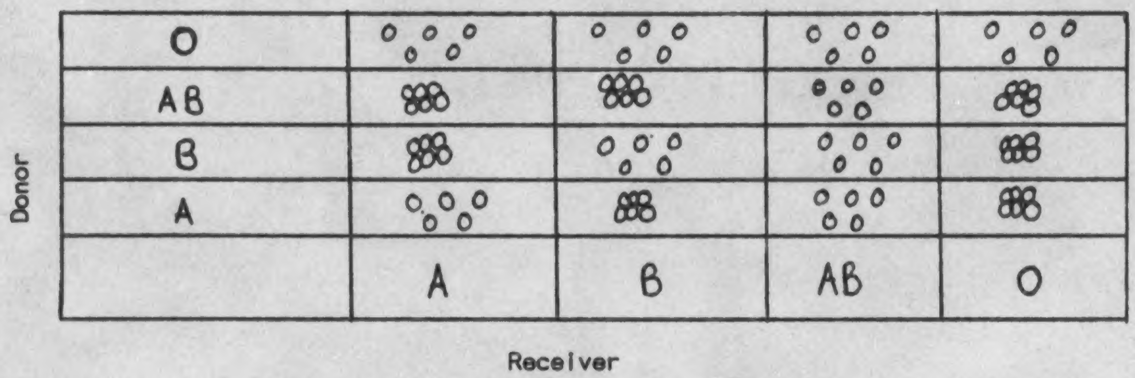
Day 2

1. The students should read the section on blood types. As they read they should refer to the testing which was done the previous day.

2. After the students have read the section, the teacher should explain, in detail, the test which was done the previous day. The method of blood typing should be discussed, and the results should be evaluated and the students' blood typed.

3. For additional information, the students could be given the chart which shows blood types are comparable. (See below.)

BLOOD DONORS CHART



This chart shows which blood types can be given in transfusion to persons with any of the four blood groups. It also shows the type of blood that persons with any of the four blood groups can receive. The circles touching stand for different blood proteins which, when added together, clump causing death. The circles standing apart stand for different blood proteins which when added together mix without clumping. All the races have the same four blood types.

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SECTION: 7.10 Blood and Its Functions
Page T-68/S-214 The Lymphatic System Is Another Transport System
(50 min.)

ADVANCE PREPARATION: Materials - Make a chart/transparency of Figure 7-10.

Language Cards/Key Signs
tissue fluid
lymph ducts
the lymphatic system
lymph
lymph nodes
infection

TEACHING SUGGESTIONS:

Day 1

1. During the lesson, the chart/transparency of the system should be displayed on the board.

2. The students and teacher should read through the section. The teacher should explain each vocabulary word as it occurs.

3. When the class has finished reading the section, the teacher should review all vocabulary on the lymphatic system.

Day 2 - Evaluation

1. The students should read the Highlights section. The teacher should ask the students questions about the concepts of this section.

2. The students should write answers to the Checkpoints. The teacher should paraphrase the questions where necessary.

3. When the students have completed their answers, they should discuss them with the class.

****

Level 7 Unit 2 Life Systems

Chapter 7 Transport Systems

Transport in Plants

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-69	7.13	Water Moves Up in Plants (Experiment Only)	50 min.
T-68	7.12	Plants Have Transport Tissues + 7.13	50 min.
T-69	7.14	Food Moves Up and Down in Plants	90 min. (2 days)
		Evaluation	

SECTION: 7.13, 7.12 Transport in Plants
Page T-69, 68/S-219, 218 Water Moves Up in Plants, Plants Have Tranport Systems (50 mins. + 50 min.)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials for experiment. Also have prepared slides of plant stems and root hairs. Make a transparency/chart of Figure 7-23, with labels. Make a ditto of the chart in Figure 7-25. Write out the directions for the experiment on chart paper/transparency.

Language Cards/Key Signs
xylem cells
cambium
root hairs

Identification Cards
(Labels for materials in experiment)

TEACHING SUGGESTIONS:

Day 1

1. The teacher begins by displaying the materials for the experiment and the directions.
2. The students read the directions and refer to the materials. As the students read about a particular materials, the label should be placed on the material.
3. Each student should take a copy of the chart and appropriate materials. The students should first set up the experiment.
4. One student can be the time keeper. At each ten-minute interval, the students follow the directions and record the information.
5. When the students have filled in the chart each time, the class can discuss the possible outcomes and the reasons for such outcomes.
6. Also during the time the students are not recording data, they could go to microscope stations and look at prepared slides of stems.

7. After the students have completed the experiment, they discuss the results and possible reasons for them.

Day 2

1. Beginning with section 7-12, the students read through the text.

2. After completing section 7-12, the students continue with section 7-13. At this point the teacher displays the copy of Figure 7-23 and discusses it with the class.

3. The teacher should be sure and emphasize all of the figures in the section.

4. After reading the section on root hairs, the students should look at prepared slides under the microscope. They should discuss what they have observed.

5. At the end of the class, the teacher should first review all of the vocabulary. Second, the students should again discuss the experiment of the previous day and explain the results using their new vocabulary.

****

SECTION: 7.14 Transport in Plants
Page T-69/S-222 Food Moves Up and Down in Plants (90 min. - 2 days)

Language Cards/Key Signs
phloem
cambium
to reproduce
sap

ADVANCE PREPARATION: Materials - If possible, have a cross section of a tree in the class. Also purchase some real maple syrup and ice cream to bring to class. Transparency of Figure 7-25 from the previous lesson will be used. Make a ditto of the cross word puzzle (omit #7 and #10.) Also make a list of possible answers to go with the puzzle.

TEACHING SUGGESTIONS:

Day 1

1. The teacher begins the class by showing the students the cross section of the tree. The students discuss the structures which they can observe. The teacher explains about the growth rings of the tree.

2. The students read section 7-14. The teacher should explain each vocabulary word as it occurs. The teacher should also explain again the movement of sap in the tree and then ask several students to explain it.

3. The teacher should display the copy of Figure 7-25. The students should discuss the transport systems and give the proper names to the tubes.

4. The teacher tells the students that if each student can explain where maple syrup comes from, they will have a 'treat.' After each student explains the process, the teacher gives the students ice cream with maple syrup on it (or anything else with maple syrup).

Day 2 - Evaluation

1. Students read the Highlights section and the teacher asks them questions about

the concepts in this section.

2. The students write the answers to the Checkpoints. After the students have completed their answers, they should discuss them.

3. The students should do the Skullduggery (in class or at home). The teacher should give the students a list of the possible answers (from the teacher's manual). #7 and #10 should be crossed out on the puzzle.

4. The teacher should read What's Next? to the students. The class should discuss the information.

****

Level 7 Unit 2 Life Systems

Chapter 8 Internal Communication Systems

Nervous Systems

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-72	8.1	Neurons Send Signals	50 min.
T-72	8.3	Many Neurons Make a Nervous System	90 min.
T-72	8.2	Behavior is Caused by Neurons	50 min.
T-72	8.4	The Human Nervous System	150 min. (3 days)
NOTE: Introduction is omitted. The order of the lessons has been changed.			

SECTION: 8-1 Nervous Systems
Page T-72/S-228 Neurons Send Signals (50 min.)

ADVANCE PREPARATION: Materials - Make a chart/transparency of Figures 8-3 and 8-4. Label each picture.

Language Cards/Key Signs
- a stimulus
- a reaction
- the senses
- nerve cells
- neurons
- a cell body
- dendrites
- axon
- impulse
- synapse
- nucleus
- cytoplasm

TEACHING SUGGESTION:

NOTE: Because the students have already discussed stimulus and response, this should be used as a review.

1. The teacher should begin the lesson by reading the first part of the section (pp. 228-229). The students should review the information in these paragraphs.

2. Then the teacher and students should read the rest of the section. As the students read through page 230, the teacher should display the charts of Figures 8-3 and 8-4.

3. The class should discuss the structure of the neurons, and the functions as stated in the section.

4. At the end of the class, the teacher should ask several students to explain the transmission of information in the nervous system.

* * *

SECTION: 8-3 Nervous Systems
Page T-72/S-232 Many Neurons Make a Nervous System (90 min.)

PREREQUISITES: Basic knowledge of the nervous system and its function.

ADVANCE PREPARATION: Materials – Make large charts of each organism pictured in this section. Make additional charts of other organisms, or have the students make charts. These should be displayed in the classroom.

Language Cards/Key Signs
a nervous system
nerves
a brain
a spinal cord
vertebrae

TEACHING SUGGESTIONS:

1. The teacher should display the charts of the various nervous systems. To begin the lesson, the teacher writes The Nervous System on the board.

2. The students are to try and explain what the nervous system is. The teacher can add information with which the students are unfamiliar.

3. The teacher should read the section to the students. The teacher should explain each new vocabulary word and refer to the charts as necessary.

4. During the discussion, the students should compare their nervous system to that of other organisms.

5. After class, some students could volunteer to make additional charts about other organisms and their nervous systems.

* * *

SECTION: 8-2 Nervous Systems
Page T-72/S-231 Behavior is Caused by Neurons (50 min.)

ADVANCE PREPARATION: Materials – Collect five or six pictures of animals reacting to stimulum – other animals, man, etc. Mount each picture on heavy cardboard. Make a transparency/chart of Figure 8-5. Use teacher's manual to get instructions/materials for the experiment in section 8-2. Have a tennis ball for the class.

Language Cards/Key Signs
behavior
sensory neurons
association neurons
motor neurons
stimulus
response

TEACHING SUGGESTIONS:

Day 1

1. The teacher begins the lesson by writing the words stimulus and response on the board. The teacher then takes a tennis ball and tosses it to a student.

2. After the student reacted, the teacher describes the situation in terms of stimulus and response. The teacher then asks the students to think of other situations with stimulus-response.

3. Following the directions in Section 8-2, have the students do the experiment. The teacher first explains the experiment and then the students group in pairs and do the experiment. After the students have completed the experiment they should discuss the results.

Day 2

1. Then the students and teacher should read section 8-2 discussing their responses in terms of the information in the section.* When discussing the different reactions, the teacher should show the students pictures that show responses of organisms. (Note: It is difficult to use the picture on page 229 because it is not clear.)

2. At the end of the class, the teacher asks each student to describe a stimulus-response situation.

*The teacher should display the chart showing Figure 8-5. Each stimulus/response should be discussed in these terms.

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SECTION: 8-4 Nervous Systems
Page T-72/S-236 The Human Nervous Systems (150 min. - 3 days)

ADVANCE PREPARATION: Materials - See attached sheet for directions for the brain dissection. Have dissection equipment available. Make a chart/transparency of Figure 8-13 and Figure 8-14.

Language Cards/Key Signs
the central nervous system
the peripheral nervous system
the cerebrum
the cerebellum
the medula

Identification Cards
labels for brain
and nervous system

TEACHING SUGGESTIONS:

Day 1

1. To begin the lesson, the teacher explains what the class will do. The teacher displays the brains and tells the students that they will look at the structure of a brain that is similar to the human brain.

2. The students should then perform the dissection. As the students are working, the teacher should move around the class helping the students to identify the parts of the brain. The teacher could write the names of the parts on the board during the class. (See attached sheet for dissection tips and directions)

3. When the students have completed their dissections, they should discuss their observations.

Day 2

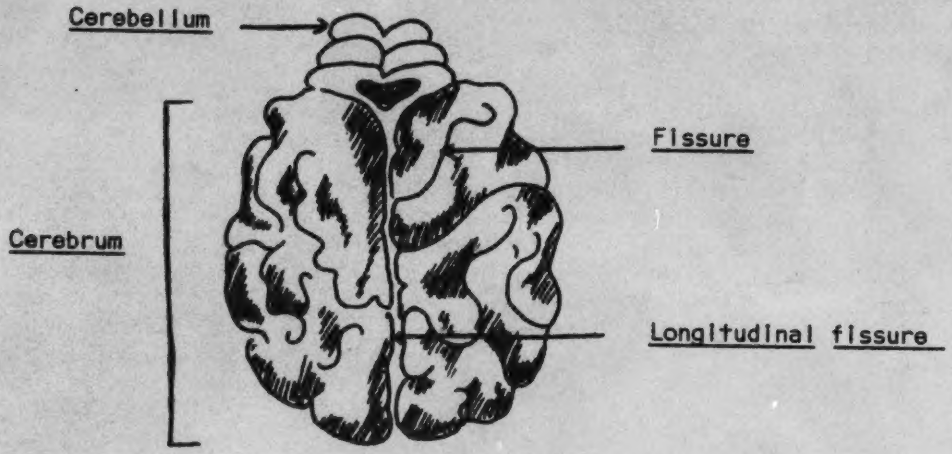
1. The teacher and students should read section 8-4 discussing the information and vocabulary. During the discussion, the teacher can display the chart/transparency of the nervous system. The students should discuss each part of the system.

2. The students should then discuss the structure of the brain. During the discussion, the teacher should have the students compare the human brain to the brain which they dissected previously.

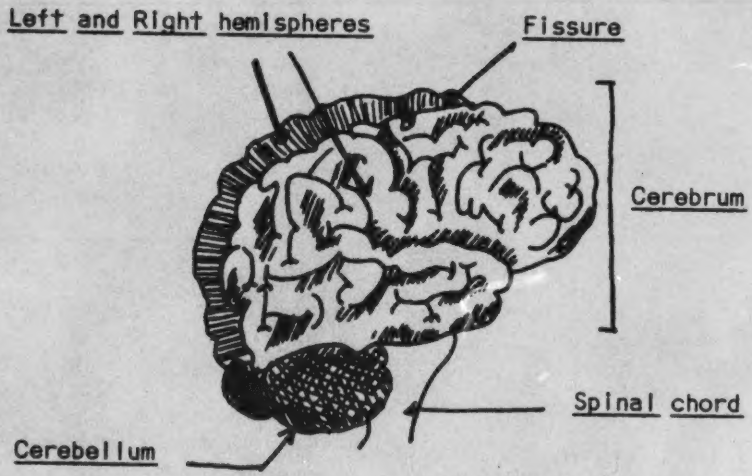
3. At the end of the class, the teacher should ask the students to name the parts of the nervous system, and name the parts of the brain and describe their functions.

BRAIN DISSECTION

Unlike looking at a heart or an eye, examining the brain won't give many clues to how it operates. Still, you might find it interesting to take a closeup look at the most complex and mysterious of organs. Beef brains come to the butcher in big bags. By the time they arrive, they are somewhat scrambled, so you might have to settle for two halves and assorted parts. Better, order one from a meat packer. Ask for one with the stem attached. (Use of a fetal pig brain would work also.)

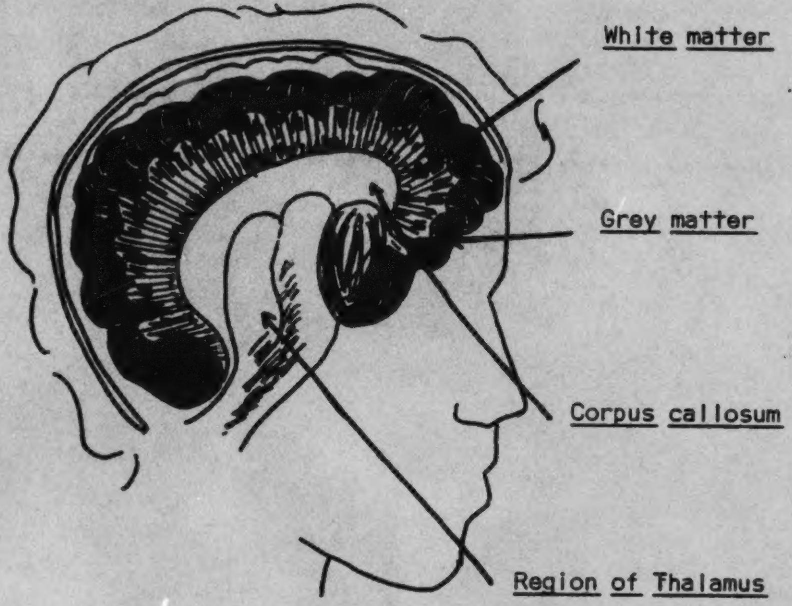

Cerebellum
Fissure
Cerebrum
Longitudinal fissure

Top View of Brain


Left and Right hemispheres
Fissure
Cerebrum
Spinal chord
Cerebellum

Side View of Brain

(1) Look at the outside. Notice the thin outer skin (pia mater) and the supplying blood vessels. In the skull, the soft brain floats in a nutritious liquid cushion and is protected by a tough coat called the dura mater.


White matter
Grey matter
Corpus callosum
Region of Thalamus

Internal View of Brain

(2) To observe internal structure, cut one hemisphere in half, lengthwise, near the longitudinal fissure.

1010

Day 3

1. The students should read the Highlights. The teacher can ask the students questions about the concepts covered in this section.
2. The students should write their answers to the Checkpoints. The teacher should change the language of the questions so they are understood by the students. Eliminate question #5.
3. When the students have completed their answers, they should discuss them with the class.

****

Level 7 Unit 2 Life Systems

Chapter 8 Internal Communication Systems

The Senses

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-73	8.5	The Sense of Sight	150 min.(3 days)
		Aids for the Blind	100 min.(2 days)
T-74	8.6	The Sense of Hearing	200 min.(4 days)
T-74	8.7	The Sense of Smell and Taste	50 min.
T-75	8.8	The Skin and Body Have Many Senses	50 min.
T-75	8.9	There Are Differences Among Animal Senses	90 min.(2 days)

SECTION: 8.5 The Senses
Page T-73/S-239 The Sense of Sight (150 min. - 3 days)

PREREQUISITES: Basic knowledge of the eye (from Level 6 - Invisible Systems)

ADVANCE PREPARATION: Materials - Make a large chart/transparency of the eye. Write labels for the chart on cards.* The materials for the experiments are listed in the attached sheets and teacher's manual. Write out directions for each experiment on chart paper. Set up stations - with the experiments listed for day one. Each experiment station should have directions, necessary materials, and paper for recording results.

*Also make a ditto of the eye. Write the labels at the bottom of the page.

Language Cards/Key Signs
sight
the cornea
the iris
the pupil
the lens
the retina
rod cells
cone cells
the optic nerve
blindness

Identification Cards
(Labels for picture of the eye)

TEACHING SUGGESTIONS:

Day 1

1. The teacher sets uo the following experiments as stations: Keep Your Eye on the Ball, Seeing is Believing, Hole in Your Hand, Stereo Vision and page 241 (experiment from textbook).

2. To begin, the teacher and students "walk through" each station, reading the directions and discussing how the experiments should be done.

3. Then, the students go to different stations, do each experiment and write down the results.

4. When all students have gone to each station, the group meets for a discussion of the results of each experiment.

Day 2

1. The teacher places the chart of the eye on the board at the beginning of the lesson. The students should read through section 8-5 with the teacher. They should refer to the chart as each part of the eye is discussed.

2. When the pupil is discussed, the teacher has the students sit in pairs and observe the action of the pupil as lights are turned on and off. (See Going Further, Day 2.)

3. At the end of the class, to review the structures of the eye, the teacher asks the students to label the parts of the eye (on the large chart).

(Day 1)

KEEP YOUR EYE ON THE BALL

Your eyes work by teamwork. Each eye sees the same thing from two slightly different angles. To test the teamwork of your eyes, try the following experiment: You will need a ping-pong ball, an eye patch and a friend.

-you get 15 trys to catch the ball with open eyes
-then 15 trys using one eye only
-trade with your partner, this time you toss
-keep track of your scores. If this is too easy, you might try catching the ball with one hand only.

SEEING IS BELIEVING

"I saw it with my own eyes." Sometimes your eyes lie. Here is an activity to explore this. It works on the principle that each eye sees a slightly different view of the world. For instance, you can turn two fingers into a floating solid bar.

Hold your index fingers tip to tip about 5" away from your eyes.

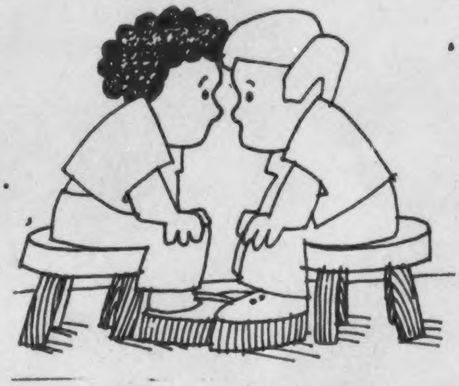
Now focus on some object in the distance.

What happens to your fingers?

(Day 2)

GOING FURTHER

For this activity, you will need two partners and a dark room. Ask one of your partners to control the lights. Sit facing your partner, as close as possible. Now have your partner turn off the lights in the room, wait 30 seconds and then turn them on again. Each of you look at each other's eyes carefully. What happens to your partner's eyes? Can you explain why this happens?

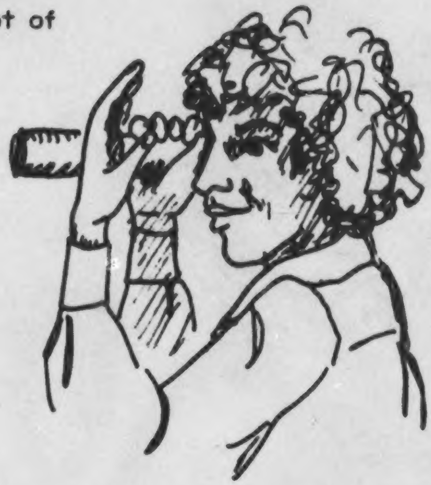


1013

HOLE IN YOUR HAND

Two eyes are not always better than one. Sometimes two images can produce a rather muddled picture of reality. However, your brain has learned to ignore conflicting images so that you "see" an edited version of the messages your eyes send your brain. Here is a way to look right through your hand.

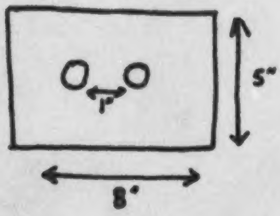
(1) For this experiment you will need to roll a sheet of paper like a telescope.
(2) Hold the telescope up to one eye and your hand up to the other eye.
(3) Move your hand slowly up and down the tube until you can see through the hole in your hand.



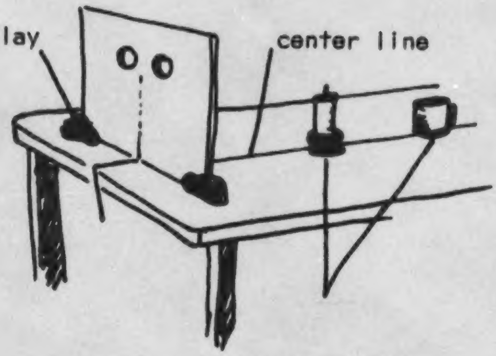
STEREO VISION

What does each eye see separately and what do they see together? Try this experiment and see.

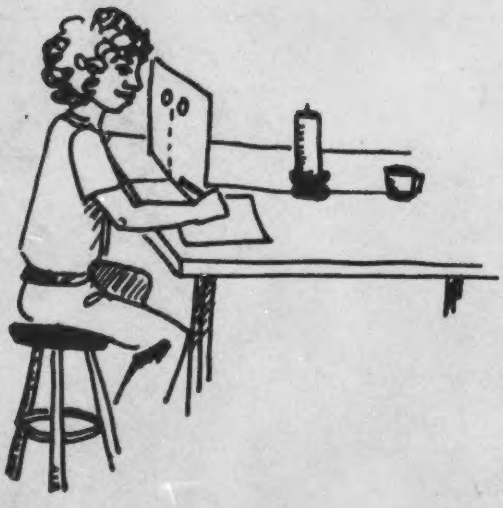
(1) Cut out a cardboard rectangle with eye holes.



(2) Set the cardboard on a table with a string or tape to mark the center.



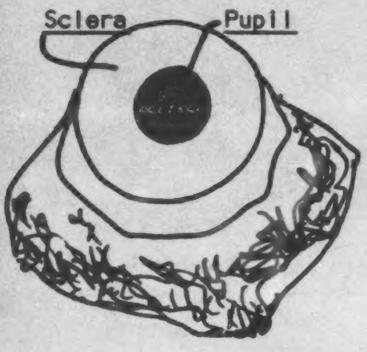
Two objects on line (one near, one far).



(3) Make three drawings of the view through the eye holes - one with the right eye covered, one with the left eye covered, and one with both eyes open.
How many views do you see?
Where are the two views combined?

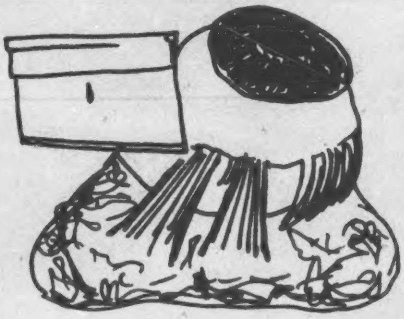
EYE DISSECTION (Day 3)

If you don't mind being stared at while you work, you will find this eye dissection to be fascinating. It may be difficult obtaining a sheep or beef eye, but it's worth the trouble. If you have no luck with your local butcher, try a slaughterhouse or meatpacker.

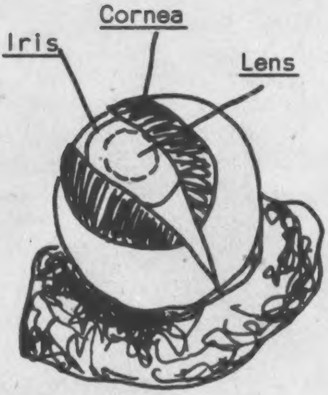


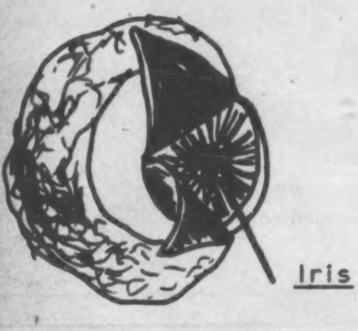
(1) The eye is held in place by muscle and fat. Muscle moves the eye while fat cushions it.

(2) Look behind the eye and you should see the optic nerve. By carefully cutting away some of the tissue, you can see how muscles connect.

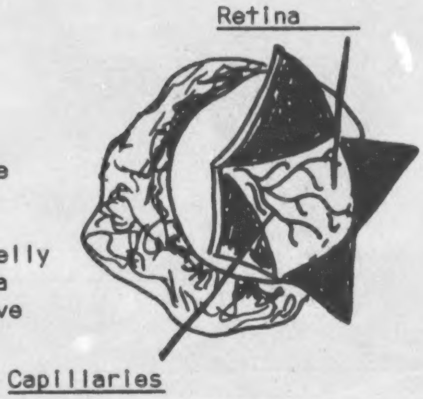


(3) Slice across the cornea and remove the lens from under the iris. (The liquid is called aqueous humor.)





(4) A crosswise cut will expose the iris. If you enlarge the cut, you can see the retina at the back of the eye. (The clear jelly is vitreous humor.) There is a blind spot where the optic nerve connects.



REFERENCES

Human physiology is the name of the subject area in which you will find answers to some of these questions. If you want more experiments of this kind, look for a laboratory book on human physiology or ask your teacher for help.

Day 3 (If you can get some eyes.)

1. The teacher passes out the dissecting equipment and eyes to each pair of students. Also the teacher displays the directions for the experiment. The students read and discuss the directions. (See eye dissection sheet.)

2. The students dissect the eyes and name each part of the eye as they observe it.

3. After the students complete the experiment, they should discuss their observations.

4. At the end of the class, the teacher passes out the worksheet on the eye. The students must label the parts of the eye.

5. When the students have finished the worksheet, they can check their answers in their books.

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SECTION: 8.5 The Senses
Page T-74/S-242 Aids for the Blind (100 min. - 2 days)

ADVANCE PREPARATION: Materials - Invite a blind adult to visit the class. That person could bring aids they use to help them. Get information from state or federal agencies on the blind, about aids for the blind, Braille, and a Braille machine.

Language Cards/Key Signs
a device
Braille
a camera
electrical signals
an image
a calculator
a computer
a handicap

TEACHING SUGGESTIONS:

Day 1

1. The students read about the aids for the blind. The teacher should display Braille samples and other information.

2. The students discuss the problems of blindness and possible ways to help with those problems (identifying canned foods, clothes, reading recipes, setting temperature on stove, etc.).

3. The students discuss the more difficult problems of a deaf-blind person.

4. The teacher helps the students develop a list of questions for the visitor, the next day.

Day 2

1. The blind person visits the class. The students ask their prepared questions and any other questions which they can think of.

2. If possible, the blind person shows some of the equipment he/she uses, and

explains what type of aids are available to the blind.

Enrichment

The students could visit a Lighthouse for the Blind or other training center for the blind - to see what methods are used in training blind persons for employment.

* * *

SECTION: 8.6 The Senses
Page T-74/S-241 The Sense of Hearing (200 min. - 4 days)

PREREQUISITES: Basic knowledge of the structures of the ear.

ADVANCE PREPARATION: Materials - Ask the audiologist for an otoscope. Also, get a portable audiometer or take the students to the school's testing booth. Use a model of the ear or make a large chart/transparency of Figure 8-17. Make separate labels for the chart. Look up information to do the "causes of deafness" section. Make a ditto of the ear. Write the labels at the bottom of the page.

TEACHING SUGGESTIONS:

Day 1
(Have the otoscope and audiometer ready for class, along with audiogram forms.)

1. The teacher begins the lesson by telling the students they will be studying the ear.

2. The teacher shows the students the otoscope, and the language card. The teacher demonstrates its use on a student, and then lets the students take turns looking at each other's ear drums.

Language Cards/Key Signs
the outer ear
the middle ear
the inner ear
the eardrum
the hammer
the stirrup
the semicircular canals
the ear canal
the anvil
the auditory nerve
the oval window
the cochlea
the eustachian
an otoscope
an audiogram

Identification Cards
Labels for pisture of ear

3. The students should discuss their observations of the ear drum, its color, and the look of the ear canal. The teacher should put up the chart on the ear, to show the students exactly what they were looking at.

4. The teacher then shows the audiometer to the students and discusses its use. The audiogram form is also shown.

5. The teacher, allowing some students to help, tests the hearing of one student and writes the information on the form. Several students can be tested to show the difference in hearing loss.

Day 2

1. The teacher displays the chart or model of the ear.

2. The students and teacher read the section. The teacher aska a student to point to and label each part as it is discussed.

3. At the end of the class, the teacher removes the labels from the chart and asks the students to replace them.

Day 3

1. The teacher discusses the causes of deafness with the students writing important information on the board (see attached sheet). The teacher should also include the particular causes of deafness of the students in the class.

2. At the end of the discussion, the teacher asks the students to list the causes of deafness.

3. The teacher passes out the worksheet on the ear. The students must label the picture of the ear.

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SECTION: 8.7 The Senses
Page T-74/S-244 The Senses of Smell and Taste (50 min.)

ADVANCE PREPARATION: Materials - Outline of a tongue (see worksheet at end of cluster), see teacher's manual for the experiment materials. Write the directions for the experiment on a chart. Make a chart/transparency of the drawing in Figure 8-18 showing the nasal cavity.

Language Cards/Key Signs
smell
taste
taste buds
nostril
sensory neurons

Identification Cards
Labels for materials in experiment

TEACHING SUGGESTIONS:

1. The teacher displays the directions for the experiment as well as the materials.

2. The students read the directions and label the materials.

3. The stuents follow the directions and do the experiment. While they are working the teacher moves among the students to discuss their observations.

4. When the students have completed the experiment, the class discusses the results.

5. The teacher then displays the chart/transparency and the students read and discuss the beginning of the section.

6. At the end of the class, the teacher asks the students how humans taste and smell different things.

****

SECTION: 8.8 The Senses
Page T-75/S-246 The Skin and Body Have Many Senses (50 min.)

ADVANCE PREPARATION: Materials - Make a transparency of Figure 8-20 with labels.

Language Cards/Key Signs
touch
sensory neurons
balance
the semicircular canals
the cerebellum
body sense

TEACHING SUGGESTIONS:

1. The teacher displays the chart of Figure 8-20,

2. The students and teacher read the section. As the students read the first two paragraphs, the teacher should refer to the Figure.

3. Before the students read the third paragraph, the teacher asks for a volunteer

to spin around very quickly. The student then tells the class how he/she feels after spinning around.

4. Then the students read that paragraph and subsequent paragraphs.

****

SECTION: 8.9 The Senses
Page T-75/S-247 There Are Differences Among Animal Senses (90 min. - 2 days)

TEACHING SUGGESTIONS:

Language Cards/Key Signs
a trained dog
an echo
high-pitched sounds
dynamite
a magnetic field

Day 1

1. The students and teacher read and discuss this section.

2. The teacher asks the students to make a list of animal senses that are different from human senses. The teacher writes the list on the board.

Day 2

1. The students read the Highlights. The teacher asks the students questions about the concepts taught in this section.

2. The students write the answers to Checkpoints. The teacher can reword the questions if necessary.

3. When the students have completed their answers, they should discuss them with the class.

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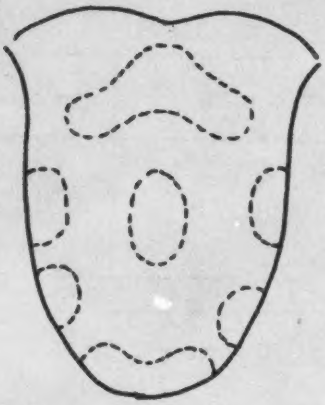
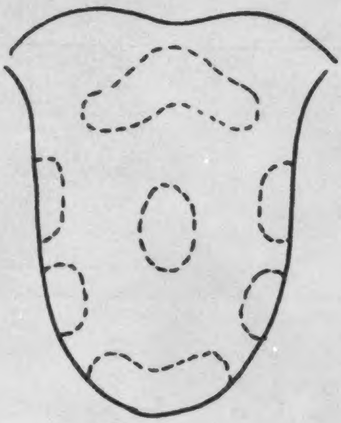
TASTE MAP

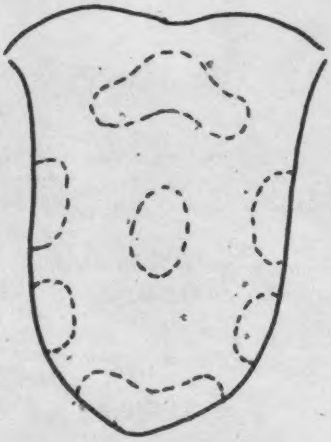
Draw asterisks (*) in the outlined areas indicating the location of the specific taste. Compare results with others.



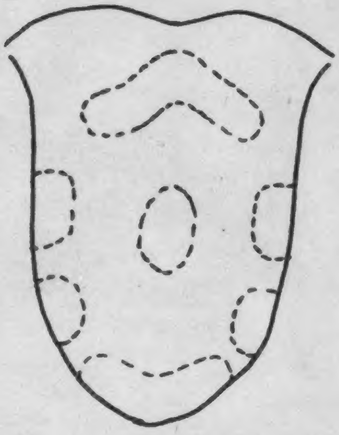
Sweet



Bitter



Salty



Sour

Level 7 Unit 2 Life Systems

Chapter 8 Internal Communication Systems

Nervous Systems and Behavior

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-76	8.10	Some Behaviors Are Reflexes	90 min.(2 days)
T-76	8.11	Many Behaviors Are Combinations of Responses	150 min.(3 days)

SECTION: 8-10 Nervous Systems and Behaviors
Page T-76/S-249 Some Behaviors are Reflexes (90 min. - 2 days)

ADVANCE PREPARATION: Materials - Ask the school nurse to visit the class during Day 1. See Teacher's Manual for directions/materials for the experiment. Write out the directions for the experiment on a transparency/chart.

Language Cards/Key Signs
reflex
an automatic response
coughing
sneezing

TEACHING SUGGESTIONS:

1. The teacher first displays the directions for the experiment on page 249. The students read the directions.

2. Then the students do the reflex experiment and discuss the results. When the students have finished experimenting on each other, the nurse should be asked to show other body reflexes (foot, eyes) in a demonstration for the class.

3. The nurse also should explain how these reflexes are used in a doctor's examination, and what the doctor is looking for when she/he does the reflexes.

Day 2

1. The students and teacher should read the section. The teacher should explain the vocabulary.

2. The students should relate the information in the section to the experiment of the previous day.

3. At the end of the class, the teacher asks the students to explain what a reflex is and to show where reflex actions occur on the human body.

****

SECTION: 8-11 Nervous Systems and Behaviors
Page T-76/S-250 Many Behaviors Are Combinations of Responses (150 min. - 3 days)

ADVANCE PREPARATION: Materials - Collect six or seven objects whose names the students know. Place them on a tray. Have a piece of cloth ready to cover the tray. See attached sheet for reasoning experiment.

Language Cards/Key Signs
- instinct
- migration
- learning
- memory
- reasoning
- trial-and-error learning

TEACHING SUGGESTIONS:

Day 1

1. The teacher should begin the lesson by asking the students several questions. How does a hamster know how to care for its young? Do all birds stay in our area during the winter?

2. The students should answer the questions to the best of their ability. The class should discuss the answers.

3. Then the students and teacher should read the beginning of this section from page 250 to page 251, column 1 (middle).

4. The students should again answer the same questions, including the information contained in this paragraph.

Day 2

1. The teacher should first display a tray with six or seven differnt objects on it. The students should be allowed to look at the tray for 30 seconds. Then the tray should be covered. The students should then write down the names of the objects on the tray.

2. When the students have completed their lists, the teacher should uncover the tray and let them check their answers. The students should then discuss the results.

3. Then the students and teacher should read the next paragraph in the section on learning. This information should be discussed in relation to the experiment.

4. Then the teacher should give the students the reasoning experiment (see attached sheet). When the students have solved the problem, they should discuss how they found an answer.

5. Then the students and teacher should read the rest of this section. The students should discuss the information in relationship to the reasoning experiment.

Day 3

1. The students should read the Highlights. The teacher asks them questions about the concepts covered in the section.

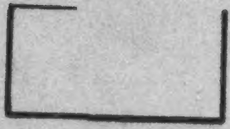
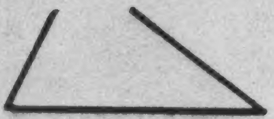
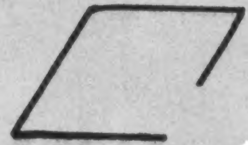
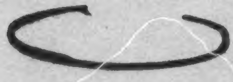
2. Then the students write the answers to the Checkpoints. The teacher should reword the questions in language appropriate to the students. For question 4, the teacher could draw a picture of the situation on the board.

3. After the students have completed their answers, they should discuss them with the class.

* * *

REASONING PROBLEMS (Day 2)

All of these are whatchamazigits.

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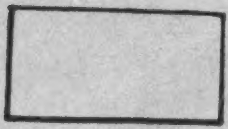
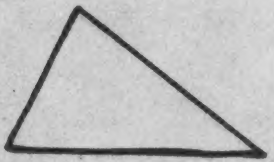
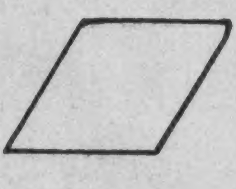
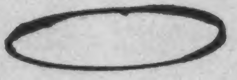

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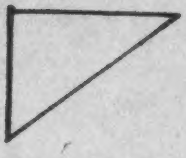
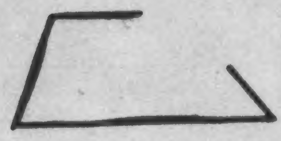
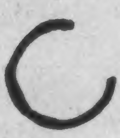
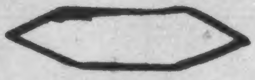

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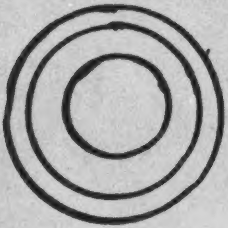

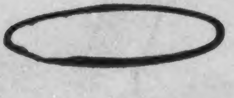

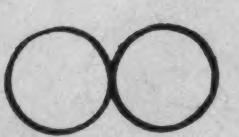

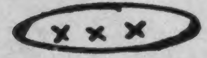

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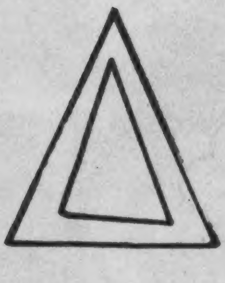
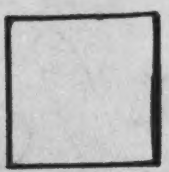
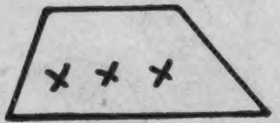
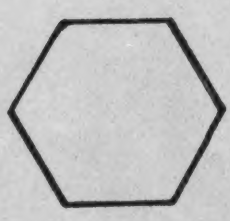
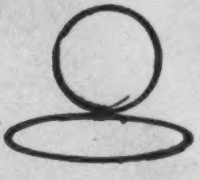


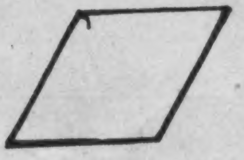


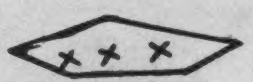


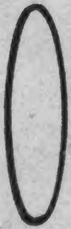


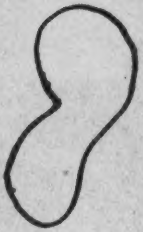
Which of these are gooneys?











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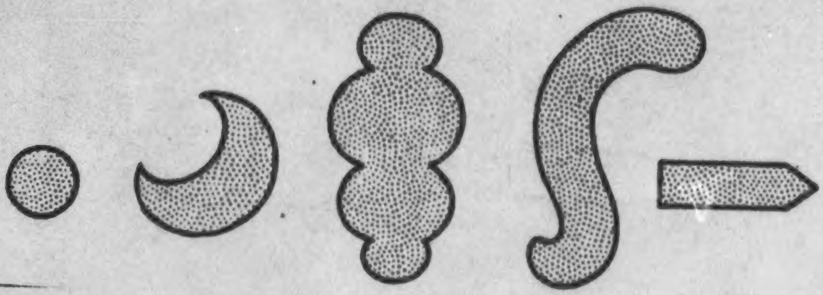
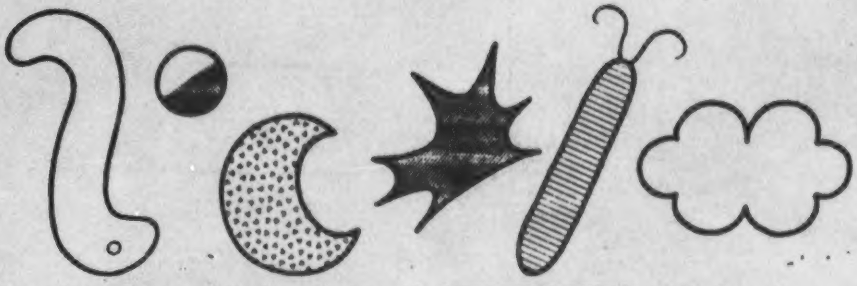
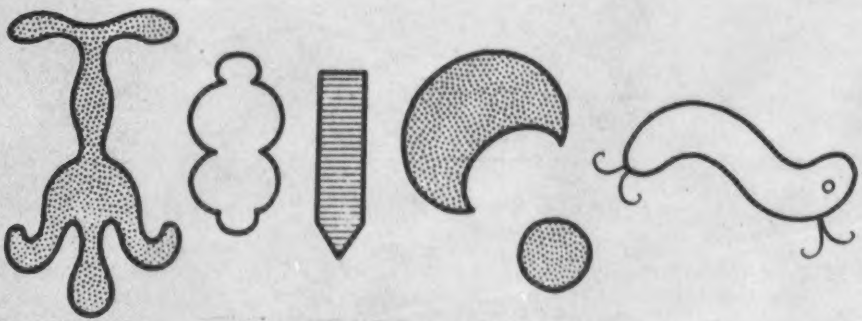


None of these are doodads.



Which of these are doodads?



Level 7 Unit 2 Life Systems

Chapter 8 Internal Communication Systems

The Endocrine System

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-76	8.12	The Endocrine Glands Produce Hormones	50 min.
T-77	8.13	Hormones and Nerves Work Together	50 min.
T-77	8.14	Plants Have Hormones	150 min.(3 days)

SECTION: 8-12 The Endocrine System
Page T-76/S-253 The Endocrine Glands Produce Hormones (50 min.)

ADVANCE PREPARATION: Materials - Make a chart/transparency of Figure 8-25. Also make a ditto of the same picture. List the labels for the pictures at the bottom of the worksheet.

Language Cards/Key Signs
the endocrine system
hormones
endocrine glands
chemicals
the pituitary glands

Identification Cards
(Labels for the endocrine system)

TEACHING SUGGESTIONS:

1. The teacher first displays the chart/transparency of the endocrine system on the board. The teacher and students refer to the picture as they read through the section.

2. The teacher reads the information in the section to the students. The class discusses the information, and the teacher places special emphasis on the vocabulary words.

3. After reading the section, the teacher using Figure 8-26 explains the different glands, and how they function, and the resulting body changes. The class discusses each set of glands and their corresponding functions.

4. The teacher then asks specific students to explain functions of specific glands.

5. To complete the lesson, the teacher passes out the worksheet. The students are to label the picture without looking at the large chart. The teacher can then post the chart again and allow the students to check their answers.

****

SECTION: 8-13 The Endocrine System
Page T-77/S-254 Hormones and Nerves Work Together (50 min.)

ADVANCE PREPARATION: Materials - Make worksheet which requires the students to match the endocrine gland with its effect on the body. Write the work sheet in language appropriate to the students.

TEACHING SUGGESTIONS:

1. To begin the lesson, the teacher asks the students to use their imagination. The teacher tells a story about a walk in the woods. A person is walking in the woods. Suddenly, the person sees a rattle snake, etc.

Language Cards/Key Signs
the brain
nerves
a reaction
the adrenal glands
adrenalin

2. After telling the story, the teacher asks the students how the person would feel and what the person would do.
3. After the discussion, the teacher and students read this section and discuss the information in relation to the story.
4. After the discussion, the teacher should again refer to Figure 8-26 and review the information in the chart. Then the teacher passes out the worksheets for the students to complete.

****

SECTION: 8-14 The Endocrine System
Page T-77/S-256 Plants Have Hormones (150 min. - 3 days)

BACKGROUND INFORMATION: See Teacher's Manual.

ADVANCE PREPARATION: Materials - See Teacher's Manual for information on the experiment on page 258. Also have several plants available to do the experiment pictured in Figure 8-28. Rewrite the directions for the experiment on page 258, placing them on a chart/transparency.

Language Cards/Key Signs
auxins
tropism

Identification Cards
(Labels for materials in experiments)

TEACHING SUGGESTIONS:

Day 1

1. To begin the class, the teacher displays the materials for the two experiments. First the students look at Figure 8-28 and discuss what is shown in the pictures.
2. Next, the students take several plants and cut off the tips of the stems. The teacher tells the students that they will be observing the plants every day to see what will happen.
3. Then the teacher displays the chart on the next experiment. The students read aloud the directions and identify the materials as they are mentioned.
4. The students can refer to the book, to look at Figure 8-29, 30. The students should them set up the experiment.
5. When the students have completed the set up, they should discuss what they predict will happen to the growth of the bean seeds.

Day 2

1. The students should now read section 8-14. The teacher should emphasize the new vocabulary. Also, the students should discuss the information in relation to the experiments of the previous day.
2. If time permits, the students could read the highlights section and the teacher can question them on the concepts covered in this section.

Day 3

1. If not done on the previous day, the students should read the Highlights and discuss the information.
2. The students should write the answers to Checkpoints. Omit question #1.
3. After the students have completed their answers, they should discuss them with the class.
4. (Optional activity) If appropriate for the language level of the students, they should do the Skullduggery. The teacher should pit a list of the answers on the board from which the students can choose.

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Level 7 Unit 2 Life Systems

Chapter 9 Reproduction

Making Copies

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
		Introduction	40 min.
T-81	9.5	Experiment Only	45 min.
T-79	9.1	Life Comes From Life	45 min.
T-79	9.2	Cells Divide in Two	100 min.(2 days)
T-80	9.3	Some Organisms Reproduce by Budding	50 min.
T-80	9.4	Regeneration is a Form of Reproduction	150 min.(3 days)
T-81	9.5	Fungi Reproduce With Spores	100 min.(2 days)
NOTE: Order of the lessons has been changed.			

SECTION: Making Copies
Page S-262-263 Introduction (40 min.)

ADVANCE PREPARATION: Materials - Collect various pictures of plants and animals. Mount each picture on heavy cardboard.

Language Cards/Key Signs
reproduction

TEACHING SUGGESTIONS:

1. The teacher reads the introduction to the students. The students discuss reproduction of the zebra and pine tree.

2. The teacher shows the students the pictures of plants and animals. The students discuss how they think these organisms reproduce. The teacher tells the class that they will learn about many different kinds of reproduction in this chapter.

****

SECTION: 9.5 Making Copies
Page T-81/S-276 Fungi Reproduce with Spores (experiment only) (45 min.)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions. Write the directions for the experiment on chart paper in language appropriate to the students. NOTE: The students do not need to use their books. (The mushroom experiment explained in section 9-5 could be set up at this time.)

Identification Cards
(Labels for materials in experiment)

TEACHING SUGGESTIONS:

1. The teacher displays the chart of directions and the materials for the fungi experiment.

2. The students read the directions and label the materials in the experiment.

3. The students group in pairs and follow the directions for setting up the experiment.

4. The experiment states that the students should place the bread in a warm, dark place. When the students have done this with the bread, give the students additional pieces of bread to moisten and place in other spots in the room. The teacher should ask a student to record the various places the bread was placed.

5. The teacher ends the lesson by telling the students that they will study the results of the experiment later in the chapter.

****

SECTION: 9.1 Making Copies
Page T-79/S-264 Life Comes From Life (45 min.)

ADVANCE PREPARATION: Materials - Get some hay for the hay-infusion experiment. Have a suitable container and boiled water to put with the hay. Have several microscopes and slides ready for the class.

Language Cards/Key Signs
Aristotle
Jan van Helmont
spontaneous generation
Francesco Redi

TEACHING SUGGESTIONS:

1. The teacher invites the students to come to class before school begins or just before classes begin. The teacher shows students the hay and boiled water. The students look at the boiled water under a microscope.

2. The teacher asks the students what will happen if the hay is left to soak in the water. The students should discuss the possibilities.

3. The teacher then asks if organisms will be present in the water later in the day. The students again discuss these possibilities. The teacher tells the students to wait until class time to find out the answer.

4. During the actual class time, the teacher reads to the class about Aristotle's and van Helmont's experiments. The teacher explains the term spontaneous generation.

5. Then the students take the water from the hay infusion and look at it under a microscope. They should compare their observations to those made earlier in the day. They should discuss spontaneous generation in terms of the experiment.

6. The teacher then continues to read the section, about Redi's experiment (NOTE: Omit Pasteur's experiment.)

7. The students discuss the idea of spontaneous generation in terms of Redi's experiment.

8. The teacher continues to read to the end of the section. The students discuss the information. The teacher asks several students to explain the term spontaneous generation and to prove that it does not happen.

* * *

SECTION: 9.1 Making Copies
Page T-79/S-266 Cells Divide in Two (100 min. - 2 days)

PREREQUISITES: To name the parts of the cell.

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for cell division. Make a transparency of attached sheet on human cell mitosis. Have a transparency sheet (blank) for each student and appropriate pens. Make a large model of the materials from the experiment on page 270, to use on the board.

Language Cards/Key Signs
chromosomes
cell division
mitosis
replication
interphase
prophase
spindle fibers
metaphase
equators
anaphase
telephase

Identification Cards
(Labels for pictures of phases)

TEACHING SUGGESTIONS:

Day 1

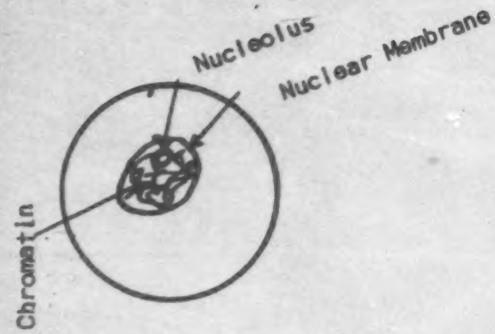
1. The teacher begin the lesson by telling the students that cells divide to make new cells. The teacher passes out a transparency and pen to each student.
2. The teacher asks the students to draw pictures of how they think a cell divides.
3. When the students have completed their drawings, each student should place the drawing on the overhead projector and the class discuss their ideas.
4. The teacher passes out the materials for the experiment on page 270. The students cut out the appropriate pieces but DO NOT follow the directions in the book for how to use the materials. NOTE: These materials will be used as the students and teacher read through the section. The teacher should also have a copy of these materials.

Day 2

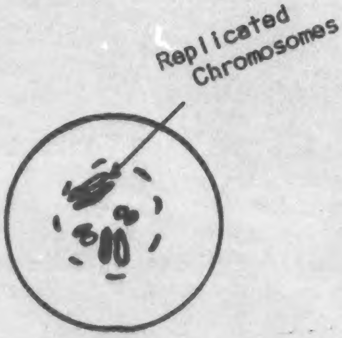
1. The students have the materials from the experiment on their desks and the teacher has the materials on the board. Also the teacher displays the transparency of the human cell division showing each part of the transparency when appropriate.
2. The students read the information in the section. The teacher explains each new vocabulary word as it occurs. As the students read about each phase, they should arrange their pieces in the proper place. After the students have placed their pieces, the teacher places the pieces on the board so that the students can check their answers. The teacher also shows the appropriate part of the transparency. (NOTE: It is important for the students to know that their cell picture is not a real cell, that most cells have more than four chromosomes, and that they are not different colors and shapes.)
3. After the teacher and students have completed the section, the teacher asks each student to show a different phase of cell division. Then these, along with labels, can be displayed on a bulletin board titled Mitosis: Cell Division.

* * *

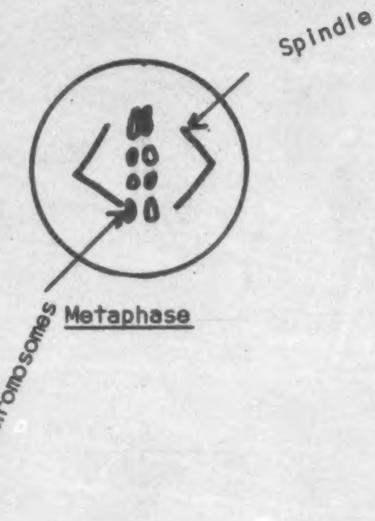
Teacher's Sheet


Nucleolus
Nuclear Membrane
Chromatin

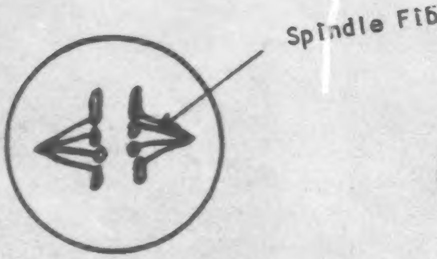
Interphase


Replicated Chromosomes

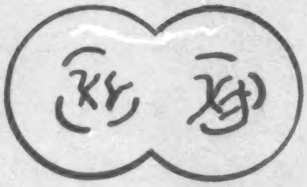
Prophase


Spindle
Replicated Chromosomes

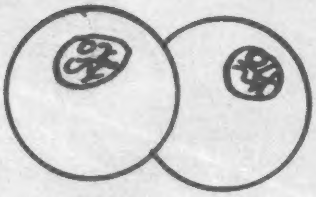
Metaphase


Spindle Fiber

Anaphase



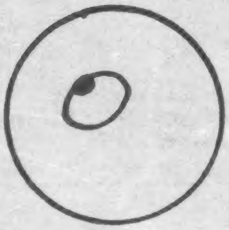
Telophase



Daughter Cells

1032

Use to Make Student Transparency



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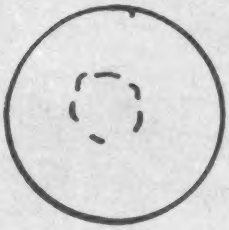

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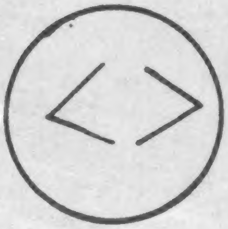

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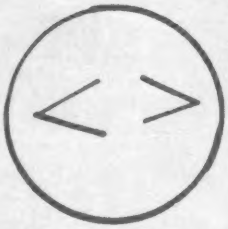

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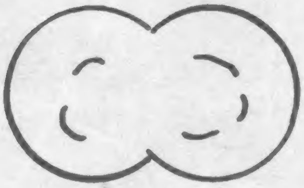

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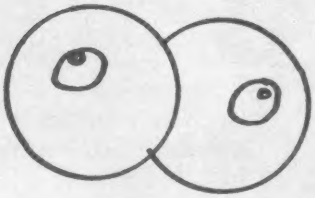

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SECTION: 9.3 Making Copies
Page T-80/S-272 Some Organisms Reproduce by Budding (50 min.)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions. Write out the direction for the experiment on chart paper.

Language Cards/Key Signs
budding
a hydra
a bud
yeast

Identification Cards
Labels for materials in experiment

TEACHING SUGGESTIONS:

1. The teacher begins the class by displaying the materials for the experiment on page 273. The teacher also displays the directions for the experiment.
2. The students read the directions and label the materials for the experiment.
3. The students perform the experiment working in pairs, each pair having a microscope if possible.
4. When the students have completed the experiment, they discuss their observations.
5. Then the students and teacher read the beginning of the section which explains what they were observing. The students should discuss Figure 9-9 and answer the questions.
6. At the end of the class the teacher asks several students to explain the observations of the yeast experiment in terms of what they have learned in this section. The students should be urged to use the new vocabulary from this section.

****

SECTION: 9.4 Making Copies
Page T-80/S-273 Regeneration is a Form of Reproduction (150 min. - 3 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for directions/materials for the two experiments. Write out the directions for the experiments on chart paper. NOTE: The students need not use their books during the experiments.

Language Cards/Key Signs
planaria
a flatworm
regeneration

TEACHING SUGGESTIONS:

Day 1

1. The teacher displays the directions and the materials for the planaria experiments. Before beginning the experiment, the teacher asks the students if they know how a planaria reproduces.
2. The students then read the directions and label the materials for the experiment. The students should begin the experiment working in pairs.
3. During the experiment, the teacher should move about the room checking on the progress of the students.
4. When the students have completed the experiment, they should discuss the possible results.

Day 2

1. The teacher should display the directions and materials for the plant experiment.

2. The students read the directions and label the materials.

3. The students should perform the experiment, working in pairs.

4. When the students have completed the experiment, they should discuss the possible results.

NOTE: Observations of these two experiments will be done daily for the next week.

Day 3

1. The students read the other parts of the section. The students discuss the information in the section.

2. The teacher should emphasize the information in the Figures and again discuss the possible results of the experiments.

****

SECTION: 9.5 Making Copies
Page T-81/S-276 Fungi Reproduce With Spores (100 min. - 2 days)

ADVANCE PREPARATION: Materials - Purchase muchrooms that are almost open. Cut a circle of 'cardboard, cut a small circle in it and stick the mushroom in the hole. Place this on a glass. In a few days spores will be visible on the cardboard. The students can look at these spores also. Make a transparency of Figure 9-14.

Language Cards/Key Signs
bread mold
hyphae
a spore
mushrooms

TEACHING SUGGESTIONS:

1. First the students make observations of the growth of mold on the pieces of bread. They should discuss the growth of mold, and also discuss the conditions of optimum growth.

2. The students and teacher read through the section, discussing the new vocabulary words and the information. The teacher displays the transparency of Figure 9-14 and discusses the parts of the mold plant.

3. The students complete the experiment by looking at the spores under the microscope. The students could also look at the spores of the mushroom.

4. The class discusses their observations of the spores and the mold. (NOTE: If a stereoscopic microscope is available, use it to look at the moldy bread.)

5. At the end of the class the students should discuss other places where they have observed mold, and the best conditions for growing mold.

Day 2

1. The students first read the Highlights section. The teacher asks the students questions about the information in this section.

2. The students write the answers to Checkpoints. The teacher can reword the questions for the students.

3. After the students have completed their answers, they should discuss them with the class.

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Level 7 Unit 2 Life Systems

Chapter 9 Reproduction

Reproduction with Special Cells

SECTION OUTLINE:

Page	Section Number	Lesson Number	Teaching Time
T-82	9.6	Many Organisms Have Sexual Reproduction	45 min.
T-82	9.7	Ferns Reproduce With Spores and Gametes	50 min.
T-82	9.8	Pines Reproduce With Cones	50 min.
T-82	9.9	Some Plants Reproduce With Flowers	100 min.(2 days)
T-83	9.10	Animal Reproduction Involves Many Behaviors	200 min.(4 days)

SECTION: 9.6 Reproduction with Special Cells
Page T-82/S-278 Many Organisms Have Sexual Reproduction (45 min.)

ADVANCE PREPARATION: Materials - Collect pictures of organisms that reproduce sexually. Also have pictures of those organisms previously studied that reproduce asexually.* Make labels for a bulletin board - ASEXUAL REPRODUCTION, SEXUAL REPRODUCTION, and sentences to go under the pictures - These organisms reproduce sexually, These organisms reproduce asexually.

*Mount these pictures on colored paper or cardboard.

Language Cards/Key Signs
- sexual reproduction
- sex cells
- gametes
- fertilization
- zygote
- asexual reproduction
- offspring

TEACHING SUGGESTIONS:

1. The teacher writes the word REPRODUCTION on the board. The teacher tells the class that they will be learning about different kinds of reproduction.

2. Then the teacher writes ASEXUAL and SEXUAL under the first title. The teacher then shows the students pictures of various organisms. The students are to guess where the pictures are to be placed. The teacher tapes each picture to the board under the appropriate title (which the students have specified). After all of the pictures have been placed on the board, the class discusses what they think sexual and asexual reproduction mean.

3. The students and teacher then read the section and discuss the vocabulary. The students should change the location of any picture which was placed incorrectly and give their reason for changing it.

4. The teacher asks several students to explain what asexual and sexual reproduction mean. The students list other organisms that they think could fit in either group. The teacher tells them if they are correct or not.

5. At the end of class (or at a later time) the class sets up the bulletin board. The students can be asked again to sort the pictures under the appropriate titles.

* * *

SECTION: 9.7 Reproduction with Special Cells
Page T-82/S-278 Ferns Reproduce With Spores and Gametes (50 min.)

ADVANCE PREPARATION: Materials - Have several fern plants for the class to observe. If possible, have a fern plant which has sori on the underside of the leaves. Have a sheet of blank paper for each student.

Language Cards/Key Signs
sori
a fern
gametes
eggs
sperm
two-stage reproduction

TEACHING SUGGESTIONS:

1. The teacher displays the different fern plants. The students should observe the plants. The teacher should point out the sori on the plant, if the students have not found them. The teacher asks the students what they think these structures are for.

2. The teacher and students read the section about ferns and rerroduction. As they read through the section, the teacher should draw the stages in the fern reproduction on the board. The teacher should label the stages and the structures explained in the text. The students should look at Figure 9-16 and discuss the reproductive cycle.

3. At the end of the class, the teacher should erase the drawings of the fern life cycle and ask the students to draw their own pictures on pieces of blank paper. The teacher should check the work.

* * *

SECTION: 9.8 Reproduction with Special Cells
Page T-82/S-279 Pines Reproduce With Cones (50 min.)

ADVANCE PREPARATION: Materials - Collect a variety of pine cones. (If time permits, collect pine cones from around the school or take the students on a field trip to collect the cones.) Have tree books available to the students so that they can label the pine cones with the name of the tree from which they came.

Language Cards/Key Signs
the reproductive organs
pollen grains
a sperm-producing cone
an egg-producing cone
pollination
fertilize
embryo
a seed

Identification Cards
(Labels for cones displayed in class)

TEACHING SUGGESTIONS:

1. The teacher should display the pine cones. The students, using the reference books, should label the cones.

2. The students and teacher read the section about the reproductive cycle of the pine tree. The teacher should draw the cycle on the board as it is discussed.

3. After the section has been completed, the teacher asks several students to explain the reproductive cycle of the pine tree.

* * *

SECTION: 9.9 Reproduction with Special Cells
Page T-82/S-232 Some Plants Reproduce With Flowers (100 min. - 2 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/direction for the Flower Dissection.* OMIT the pollen tube experiment. Write the directions for the experiment on chart paper. Make a large chart/transparency of Figures 9-18 and 9-21. If possible, have slides of different pollen grains and flower parts available for the students to look at as they do their experiment. Bring in a collection of fruits and vegetables for Day 2.

*Have different kinds of flowers to dissect.

Language Cards/Key Signs
a flower
sepals
petals
stamens
the anther
a pollen grain
the pistil
the stigma
the style
the ovary
ovules

Identification Cards
Labels for materials in experiment

TEACHING SUGGESTIONS:

Day 1

1. The teacher displays the materials for the flower experiment. The chart with directions is also displayed.

2. The students read the directions and label the materials.

3. The students, working in pairs, follow the directions and do the experiment. The teacher moves among the students to help with any problems and check on progress.

4. As the students are working, they could also be looking at the prepared slides.

5. When the students have completed the experiment, they should discuss the results. The students should have an opportunity to look at the dissection/slides done by different groups because the flowers were different.

Day 2

1. The students and teacher read the section. They should review all of the information on the flower. The teacher puts the picture of Figure 9-18 on the board and students discuss the names for the different parts on the picture.

2. The students continue reading and discussing the information. The teacher should show the picture of Figure 9-21 when appropriate.

3. When discussing Figure 9-22, the teacher should display the different fruits and vegetables. The students should cut open each piece and observe the seed structures.

4. The students should complete the lesson by listing the parts of the flower on the board and discussing the location and function of each - while referring to the picture of Figure 9-18.

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SECTION: 9.10 Reproduction with Special Cells
Page T-83/S-287 Animal Reproduction Involves Many Behaviors
(200 min. - 4 days)

ADVANCE PREPARATION: Materials - Collect pictures of invertebrates and vertebrates, with young, if possible.

Language Cards/Key Signs
vertebrates
invertebrates
territory
courtship
nesting
mating
societies
spruce trees
the spruce budworm
a chemical perticide
pheromone
a trap

TEACHING SUGGESTIONS:

Day 1 and Day 2

1. The teacher and students read the section, discussing each paragraph. The teacher shows the students various pictures of organisms and they discuss the behavior of them in relation to reproduction.

2. At the end of the two days, the students should be able to list the various behaviors of organisms during reproduction and to give examples of organisms which show that behavior.

Day 3

1. The students and teacher read and discuss "Using Reproduction to Fight Moths." The teacher may have to read the entire section to the students, explaining the vocabulary listed.

Day 4

1. The students read the Highlights. The teacher asks them questions on the concepts in this section.

2. The students then answer the Checkpoints. The teacher can reword the questions if necessary.

3. After the students have completed their answers, they should discuss them with the class.

****

Level 7 Unit 2 Life Systems

Chapter 9 Reproduction

Human Reproduction

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-84	9.11	How People Become People	100 min.(2 days)
T-85	9.12	Birth Occurs at the End of Gestation	150 min.(3 days)

SECTION: 9.11 Human Reproduction
Page T-84/S-293 How People Become People (100 min. - 2 days)

PREREQUISITES: Previously had a basic course in human reproduction.

ADVANCE PREPARATION: Materials - Using the attached sheets, make dittos of these pictures with and without the labels. Also make large drawings of them. Collect pictures of fetal development in humans. Get a movie of filmstrip which shows this development and the changes occuring in the woman's body.

Language Cards/Key Signs
pregnant
gestation
an embryo
the uterus
the amnion
the umbilical cord
a fetus

TEACHING SUGGESTIONS:

Day 1

1. The teacher should display the drawings of the male and female reproductive systems. The students should discuss the parts of each system and the function of each part. They should also discuss the growth of ovam and sperm production.

2. The students should be given a picture of each system to take home and study the parts.

3. The students and teacher should begin to read the section. The teacher should show the class pictures which were collected where appropriate.

Day 2

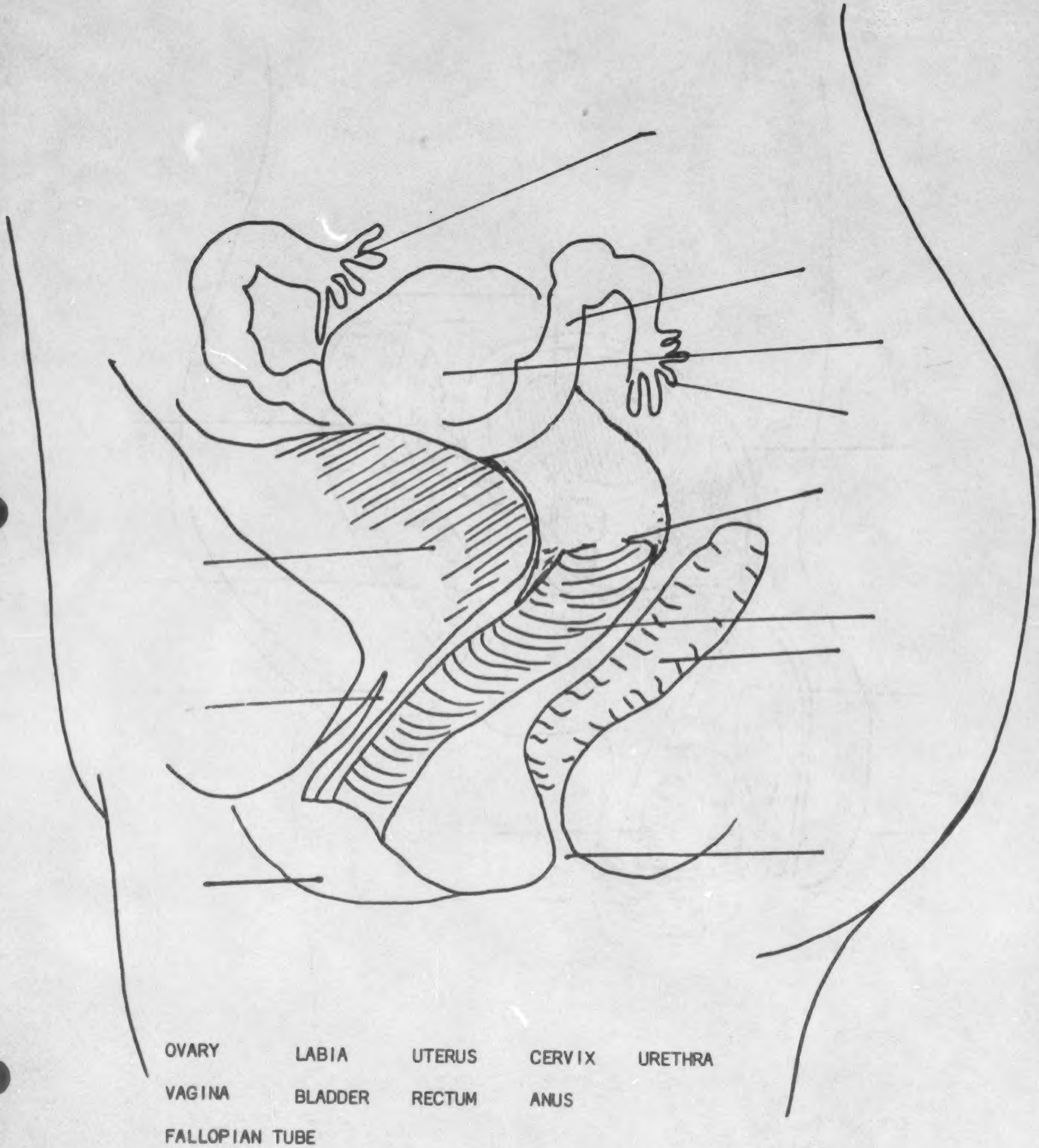
1. The students and teacher should continue reading the section and looking at pictures.

2. The teacher should show a filmstrip/movie about the development of the human. If no movie is available, pictures of fetal development can be used.

3. The students should discuss the development of the fetus and what is occuring during each month of gestation.

* * *

FEMALE REPRODUCTIVE SYSTEM

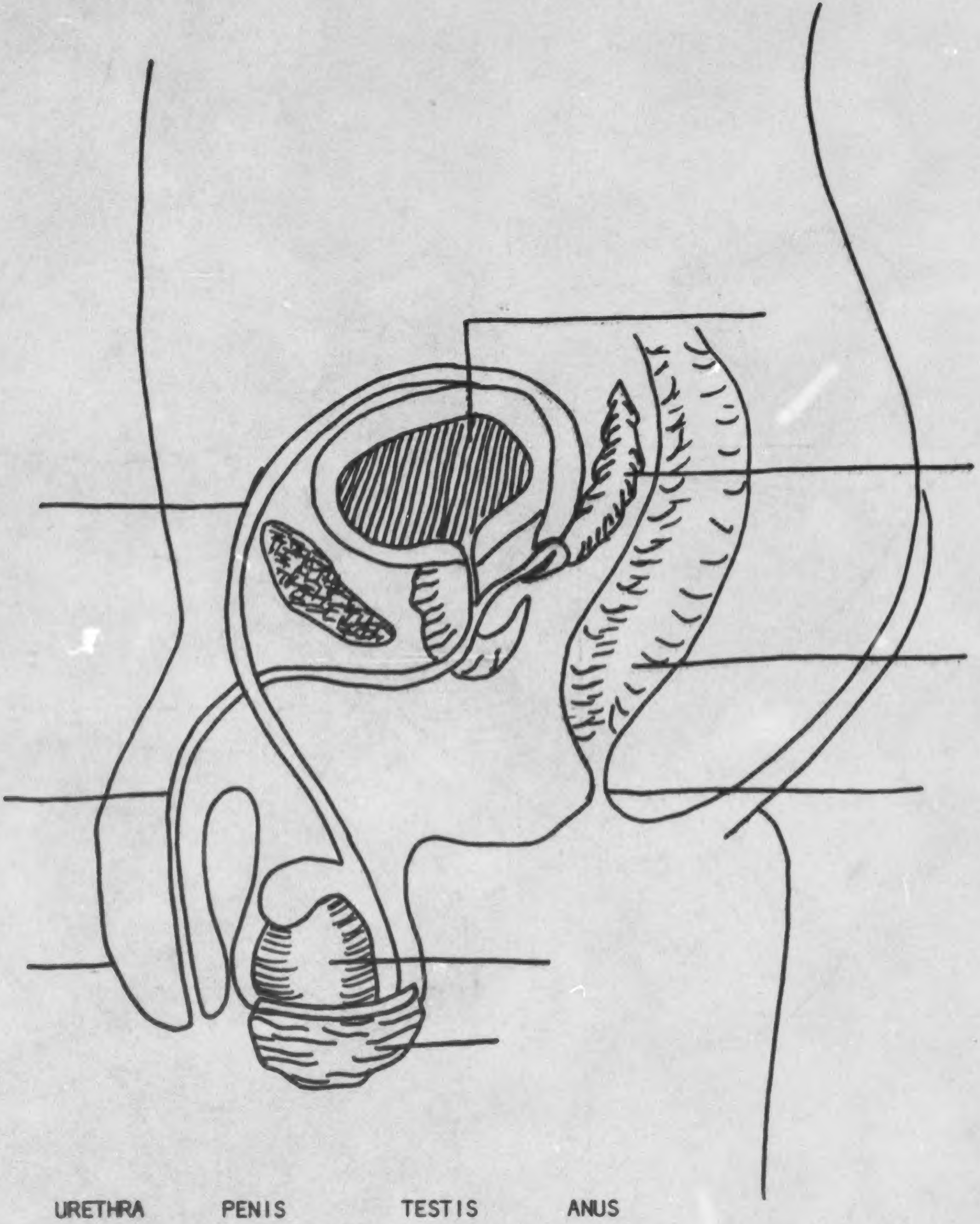


OVARY LABIA UTERUS CERVIX URETHRA

VAGINA BLADDER RECTUM ANUS

FALLOPIAN TUBE

MALE REPRODUCTIVE SYSTEM



URETHRA PENIS TESTIS ANUS

SCROTUM VAS DEFERENS BLADDER RECTUM

SEMINAL VESICLE

SECTION: 9.12 Human Reproduction
Page T-85/S-295 Birth Occurs at the End of Gestation (150 min. - 3 days)

ADVANCE PREPARATION: Materials - Use the attached sheets to make dittos of the birth process. Also make transparencies of the drawings.

Language Cards/Key Signs
contractions
labor
navel
belly button
afterbirth

TEACHING SUGGESTIONS:

Day 1

1. Using the transparencies and dittos, the teacher explains the birth process. The teacher explains the three stages of labor (dilation of cervix, birth of baby, and afterbirth).

2. The students take their dittos and place the pictures of the birth in the appropriate order. The class then discusses the birth process again.

Day 2

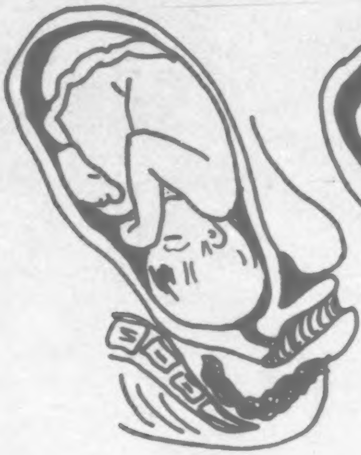
1. The students read the Highlights. The teacher asks the students questions about the concepts of this section.

2. The students will answer the Checkpoints. The teacher can reword the questions if necessary.

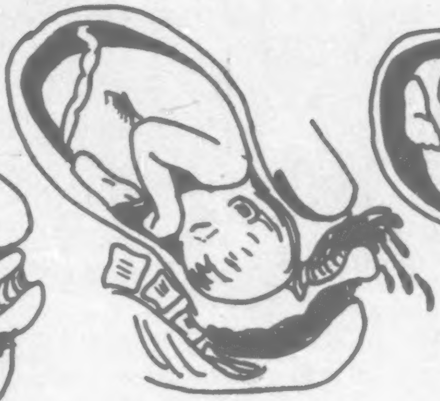
3. When the students have completed their answers, they should discuss them with the class.

* * *

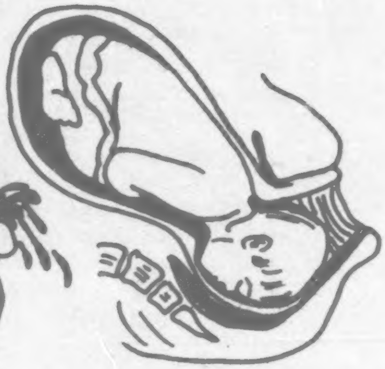
SEQUENCE OF BIRTH EVENTS



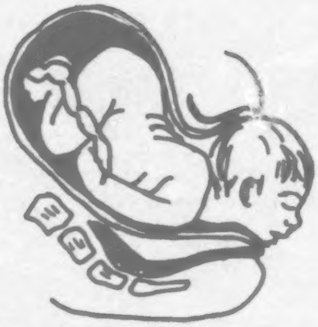
A. Lightening



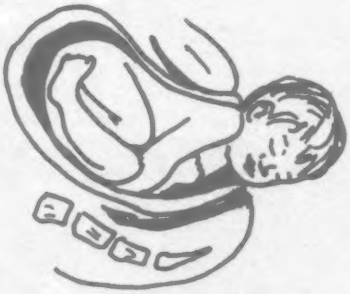
B. Contractions and breaking of the bag of waters



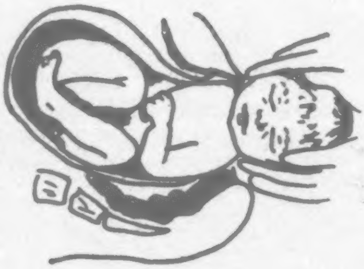
C. Dilation of the cervix



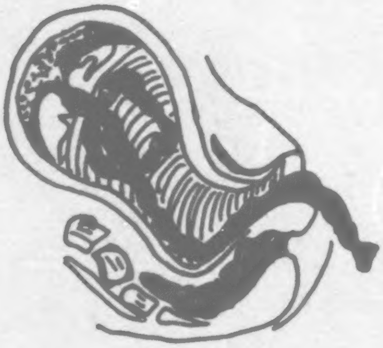
D. Episiotomy at this stage if needed



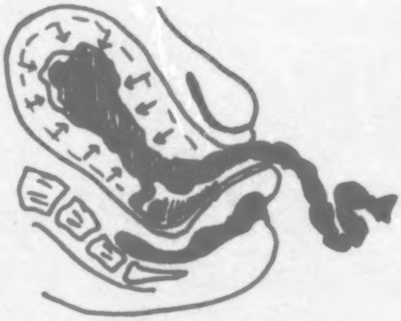
E. Delivering the head



F. Rotation



G. The afterbirth (placenta)

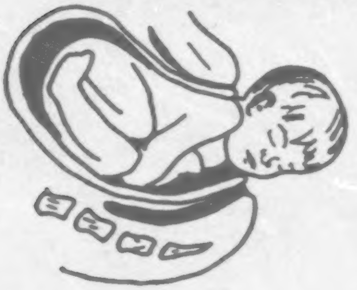


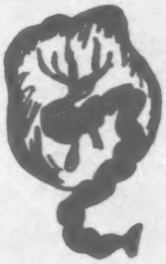
H. Uterine contractions

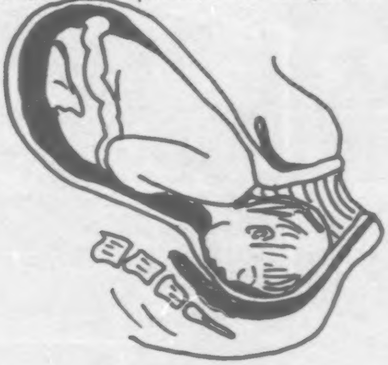
I. Expulsion of the placenta

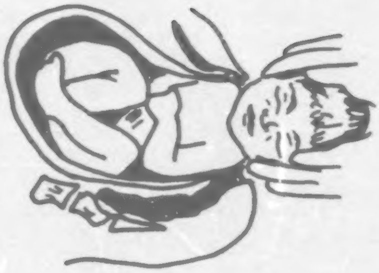
SEQUENCE OF BIRTH EVENTS

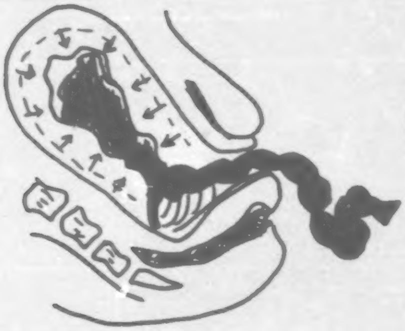
Number each event in proper order. These may be cut out and placed in sequence.

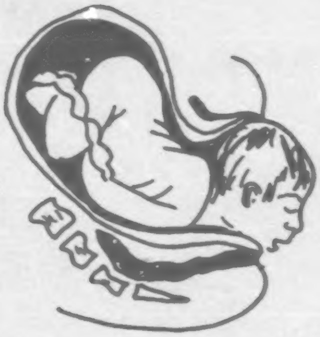


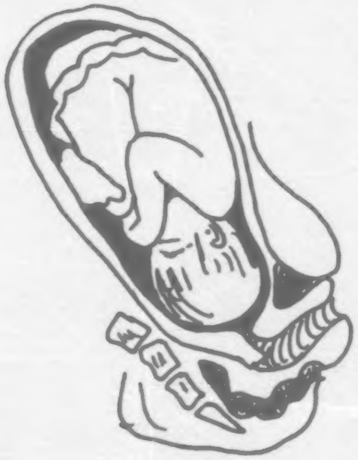


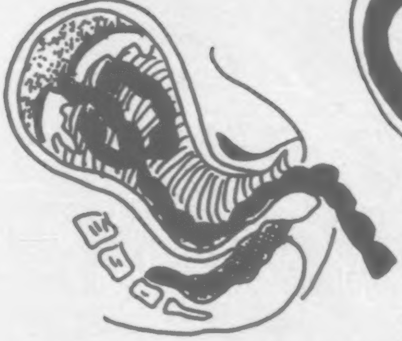


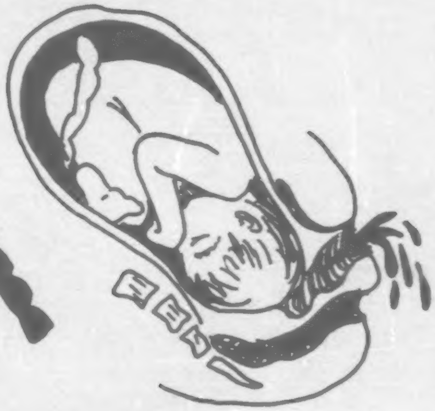






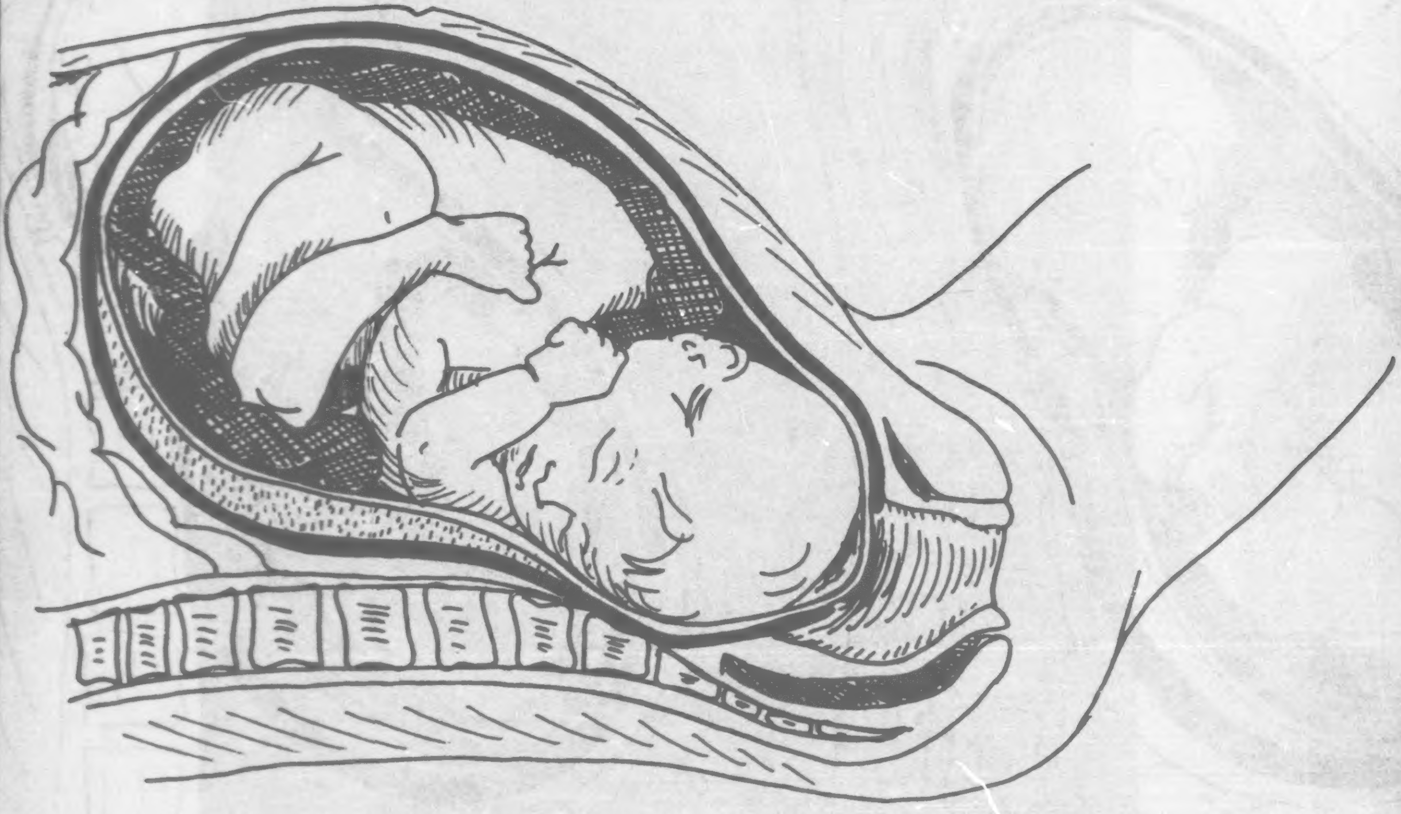






Sequence of Birth Events

1.



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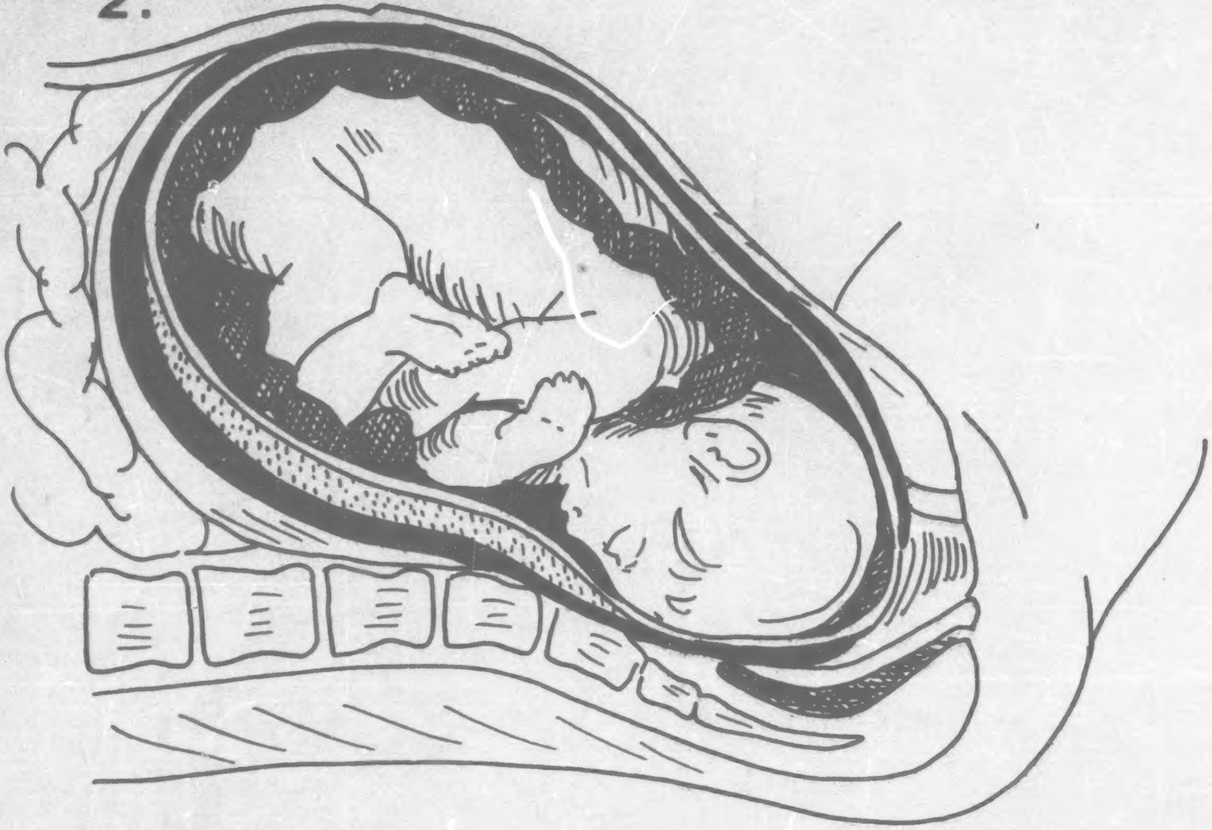
2.



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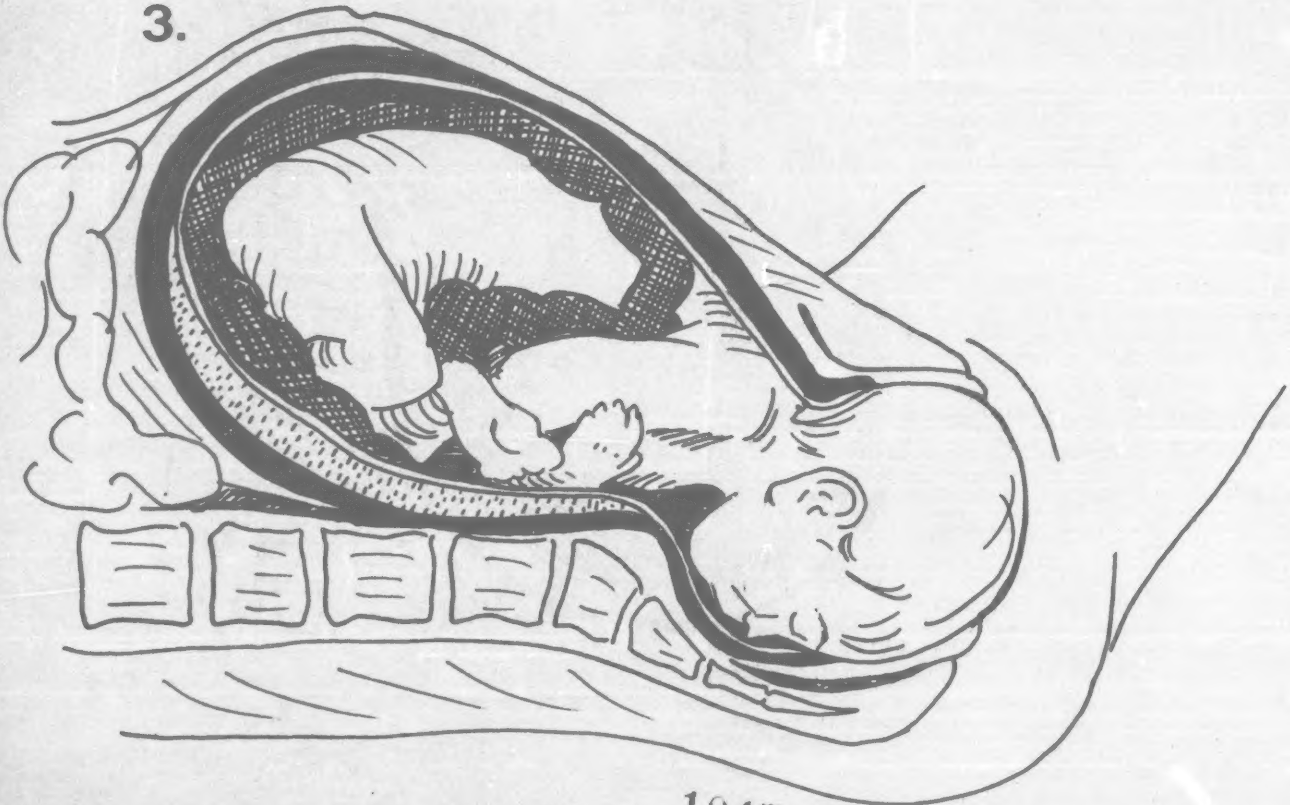

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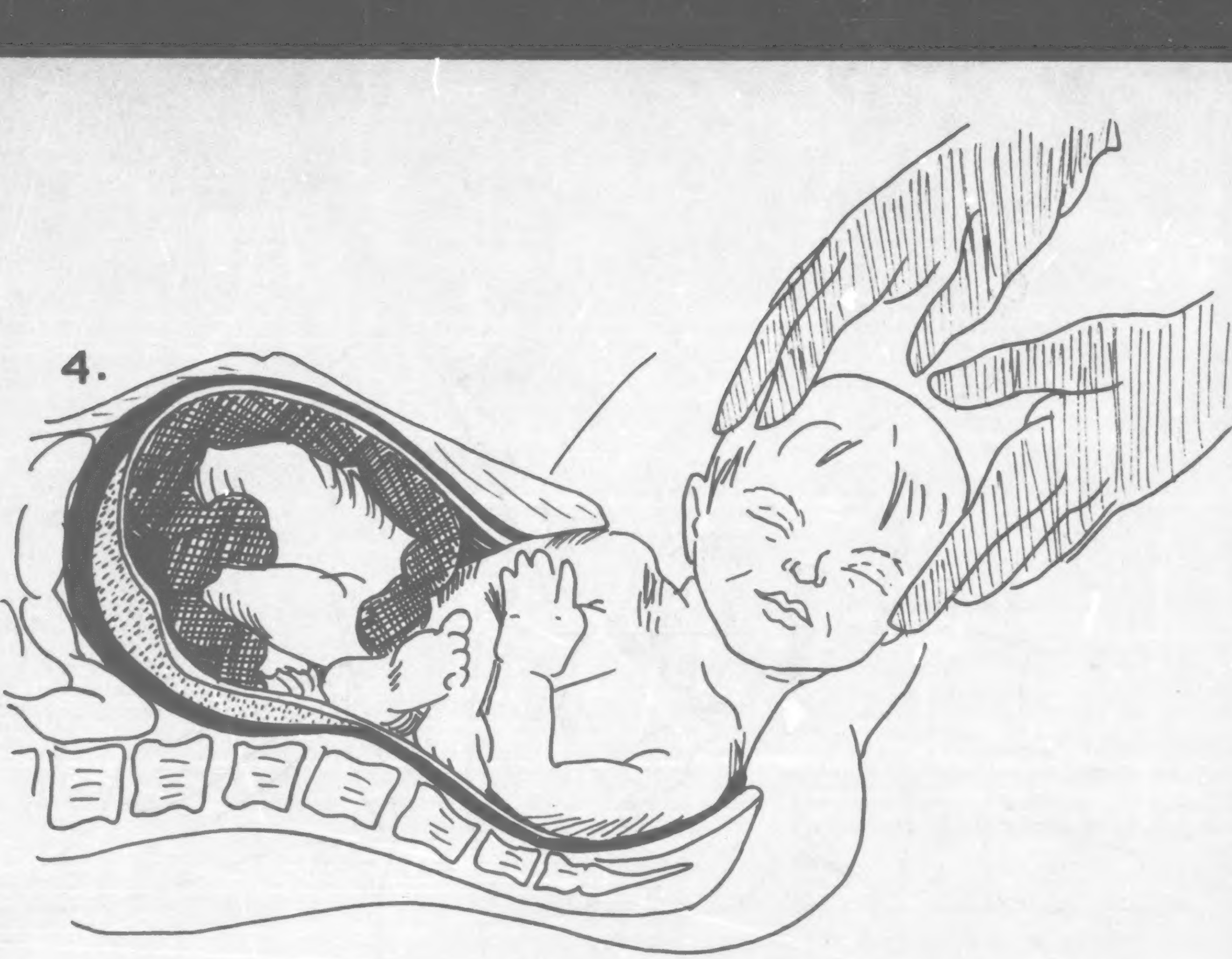

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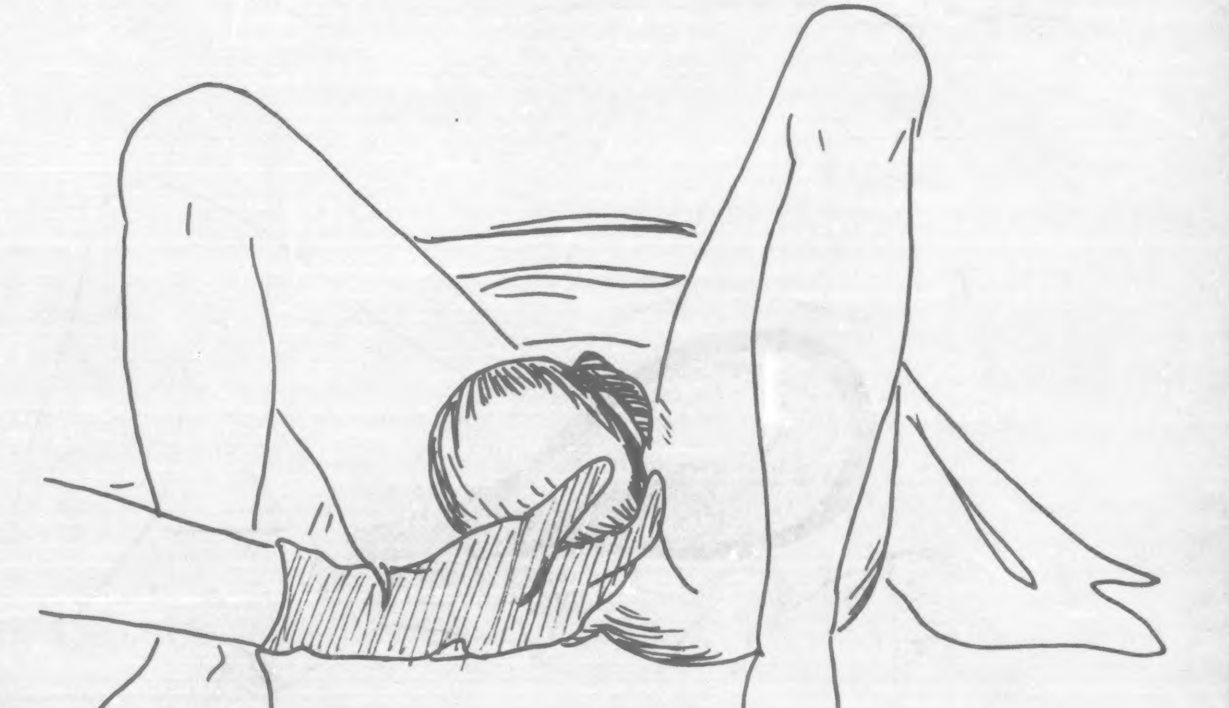

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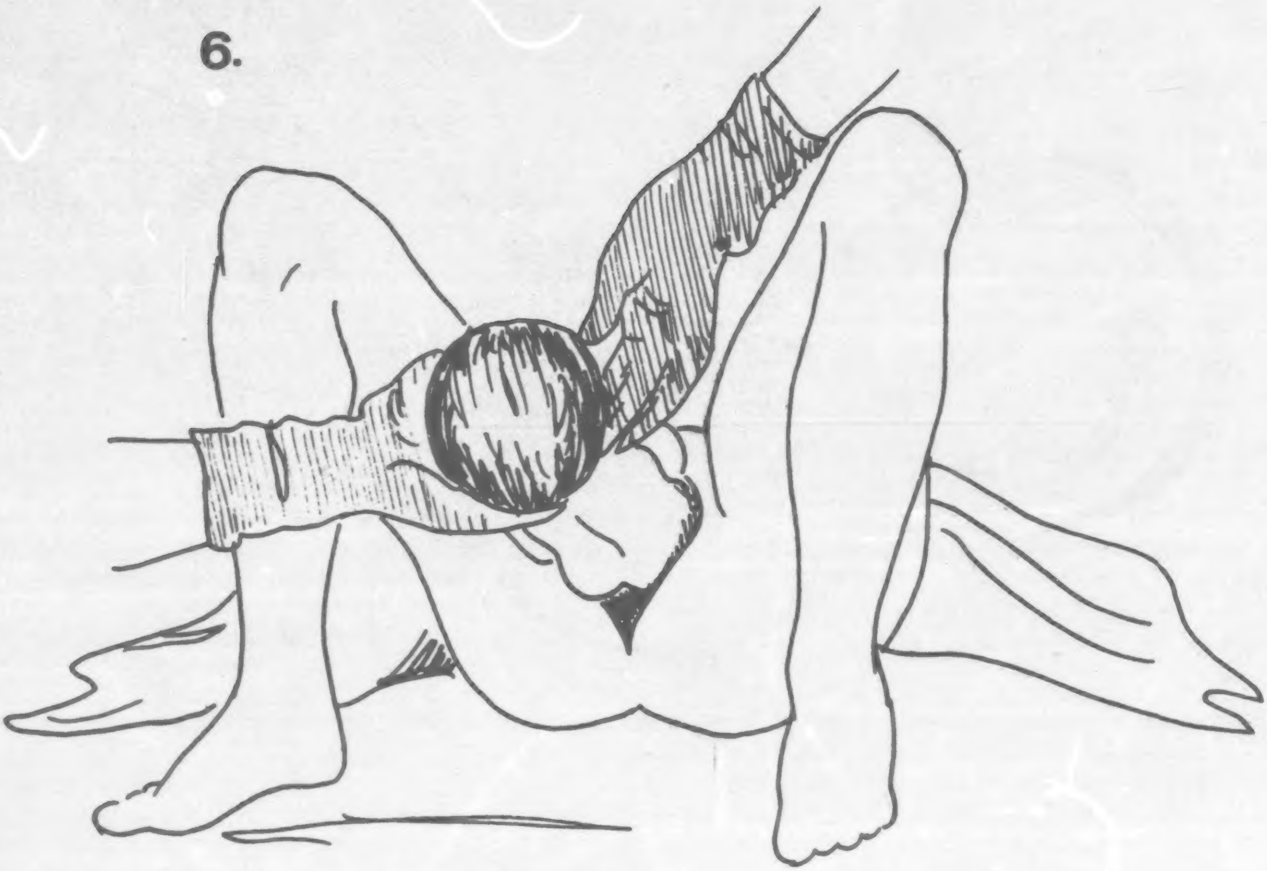
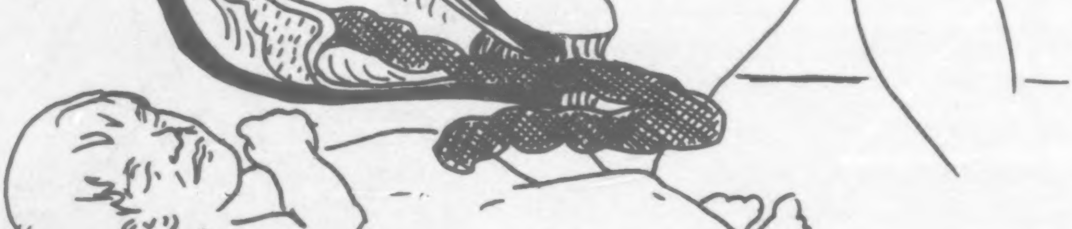


7.



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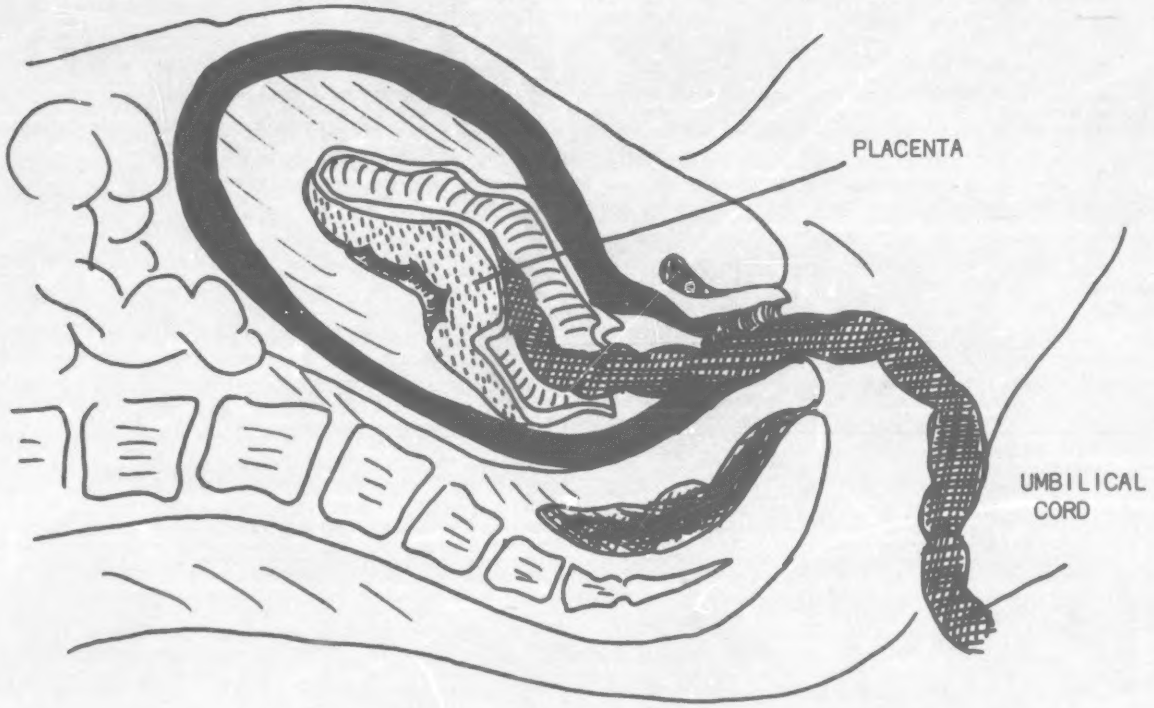
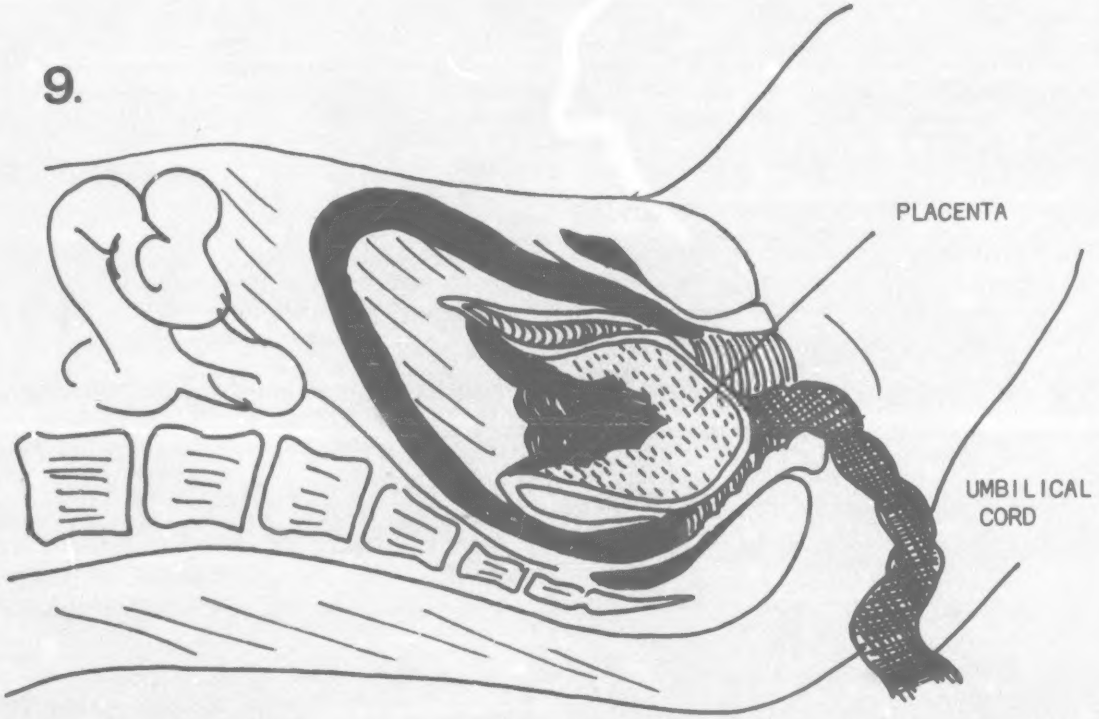

PLACENTA
UMBILICAL CORD

9.


PLACENTA
UMBILICAL CORD

Level 7 Unit 2 Life Systems

Chapter 10 Inheritance

Chromosomes Carry Traits

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
	10.0	Introduction	25 min.
T-87	10.1	The Chromosome Number is Reduced in Gametes	150 min. (3 days)
T-88	10.2	The Male Determines the Sex of Offspring	100 min. (2 days)
T-88	10.3	Some Genes are Dominant or Recessive	200 min. (4 days)

SECTION: 10.0 Chromosomes Carry Traits
Does not appear in text Introduction (25 min.)

TEACHING SUGGESTIONS:

1. The teacher reads the introduction to the students.
2. The class discusses the introduction, and the solution to the farmer's problem.

Language Cards/Key Signs
genetics
breeding

****

SECTION: 10.1 Chromosomes Carry Traits
Page T-87/S-302 The Chromosome Number is Reduced in Gametes
(150 min. - 3 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for experiment.* Have the materials used in Chapter 9 to explain mitosis. The teacher should make a large set of materials for the experiment in this section. The teacher should also have a piece of plain drawing paper for each student.

*Write directions for the experiment on chart paper in language appropriate to the students.

Language Cards/Key Signs
inherited characteristics
genes
a zygote
chromosomes
meiosis

Identification Cards
Labels for the materials

TEACHING SUGGESTIONS:

Day 1

1. The teacher, using the materials from Chapter 9, reviews mitosis. The students name the phases and discuss what happens in the cell during this process. The teacher emphasizes the fact that human cells have many more chromosomes than are shown in the example.

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2. The students look at Figure 10-2. They discuss the number and shapes of the 46 human chromosomes. The teacher explains that each sperm cell and egg cell have only 23 chromosomes. The teacher also explains that these cells are formed through a different process.

3. The teacher displays the materials and directions for the experiment on page 304. The students read the directions for the experiment. The students label the materials in the experiment.

4. First, the students make the original sperm parent cell. Then the teacher and students talk through the process. As the class discusses each phase, the students make the appropriate changes in their models.

Day 2

1. The teacher asks the students to compare the processes of mitosis and meiosis.

2. The students take their models and show the development of egg cells. Repeat the same procedures as before with the egg cells.

3. The students should discuss the fertilization process, using the information at the end of the section and Figure 10-5.

Day 3

1. The teacher and students read the beginning of the section.

2. The teacher asks the students questions about inherited characteristics, genes, and meiosis.

3. At the end of the class, the teacher passes out the drawing paper. Each student draws the process of meiosis in both egg and sperm cells. The teacher checks the students' work and displays it in the classroom.

****

SECTION: 10.2 Chromosomes Carry Traits
Page T-88/S-307 The Male Determines the Sex of Offspring (100 min. - 2 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for the two experiment. Write out the directions for each experiment on chart paper.

Language Cards/Key Signs
the sex chromosomes
meiosis

Identification Cards
(Labels for materials in the experiment)

TEACHING SUGGESTIONS:

Day 1

1. The teacher displays the materials for the first experiment on page 307. The teacher also displays the directions for the experiment.

2. The students read the directions and label the materials in the experiment.

3. The teacher explains that they will see how the sex of offspring are determined.

4. The students work in pairs and do the experiment. The teacher checks with each pair of students to see how they are progressing.

1052

5. At the end of the experiment, the students discuss the results.

6. The teacher and students read the beginning of this section (the first three paragraphs). The students discuss the information in reference to their experiment.

Day 2

1. The teacher displays the materials and directions for the experiment on page 308.

2. The students read the directions and label the materials.

3. The students, working alone, do the experiment. After they have completed the experiment, they compare results.

4. The students and teacher discuss probability with reference to coin toss and the sex of a baby.

5. The students and teacher read the last paragraph of the section.

6. The teacher uses Figure 10-6 to review what has been discussed in the section. The teacher asks several students to explain the figure.

****

SECTION: 10.3 Chromosomes Carry Traits
Page T-88/S-308 Some Genes Are Dominant or Recessive (200 min. - 4 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for directions/materials for the two experiments. Write directions for the experiments on chart paper. Make a transparency of the attached sheets on dominant and recessive traits. Collect information about Mendel and his experiment.

Language Cards/Key Signs
dominant
recessive
a first generation cross
a second generation cross
a taster
a nontaster
a pure trait
a hybrid trait

TEACHING SUGGESTIONS:

Day 1

1. The teacher displays the materials and directions for the first experiment on page 308. The students read the first paragraph of the section. Then they read the directions for the experiment.

2. The students do the experiment and record their results.

3. The students then visit other classes, taking data on tasters and nontasters.

4. The students return to class, compile the data and discuss the results.

Day 2

1. The teacher displays the materials and directions for the experiment on page 309. The students read the directions.

2. The students follow the directions and do the experiment. They make the materials, and then make the different combinations. The students record the results.

3. The teacher and students continue to read in this section. They do the second generation cross. They discuss the results of this.

4. The students and teacher continue to read up to but not including the fourth paragraph, second column, page 311. The students discuss the information in this section. They review what is meant by first and second generation cross. Then again discuss the results of the PTC test, using the new vocabulary.

Day 3

1. The teacher displays the transparency of dominant and recessive traits. The class discusses each trait and also discusses if they have a dominant or recessive trait from their family.

2. The teacher then tells a story about Mendel. The teacher explains the information and adds other information about his research.

3. The students read the rest of the section. The class discusses the different ways dominant genes have controlled growth of organisms.

Day 4

1. The students read the Highlights. The teacher asks them questions about the concepts in this section.

2. The students write the answers to the Checkpoints. The teacher may reword the questions if necessary.

3. When the students have completed the questions, they should discuss their answers with the class.

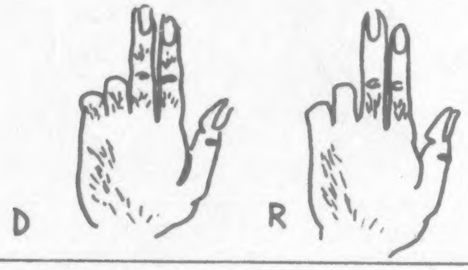
****

WHY YOU LOOK THE WAY YOU DO

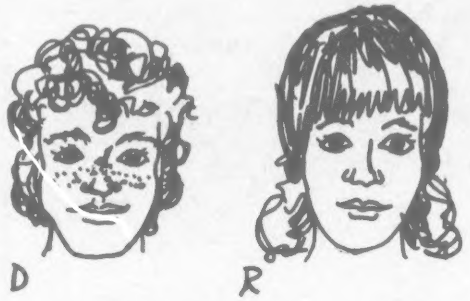
Human genetics is very complicated. It is estimated that more than 40,000 genes are needed to produce the blueprint for You. There are many variations in a human blueprint. Some of these variations or traits show up more often than others. Some variations are internal, like blood type, and others are very obvious, like eye color.

Some traits are Dominant (D) and others are Recessive (R). This means that if you inherit a gene for blond hair from one parent and a gene for dark hair from the other parent, you'll probably have dark hair. Dark hair is dominant.

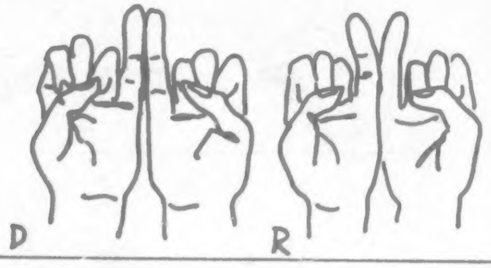
Hair on middle joints of fingers



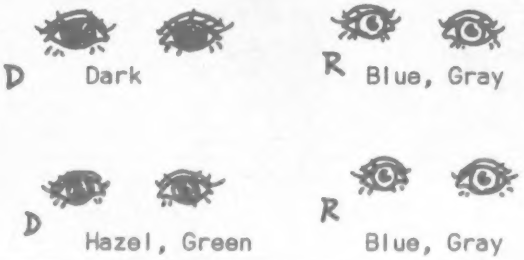
Freckles



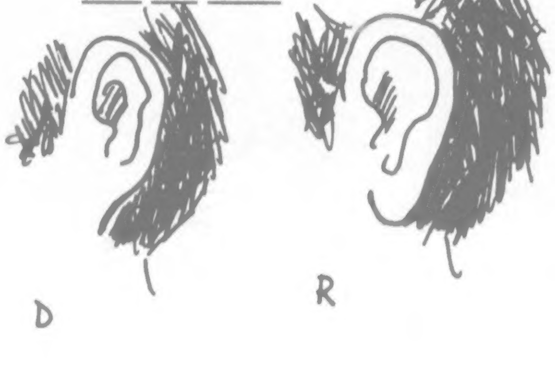
Bent little fingers



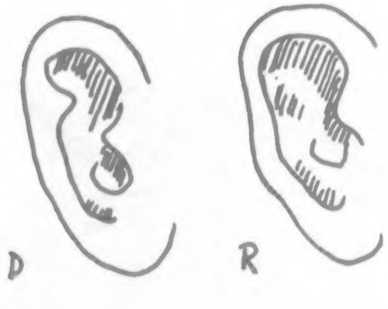
Eye color



Free ear lobes



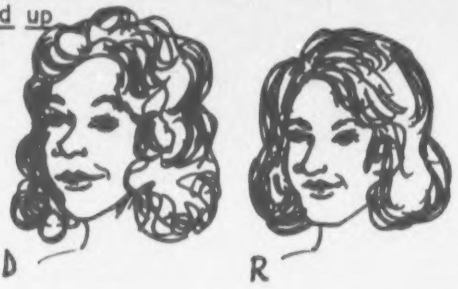
Ear points



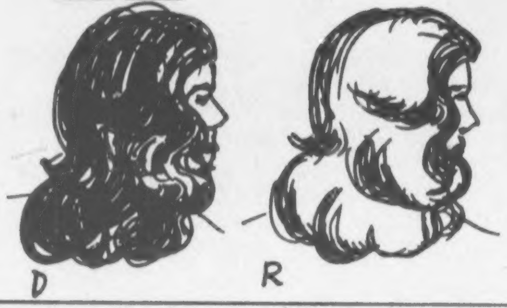
INHERITED TRAITS

Check your trait with those below. Compare with others.

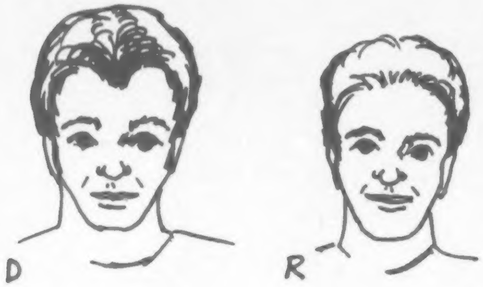
Turned up nose



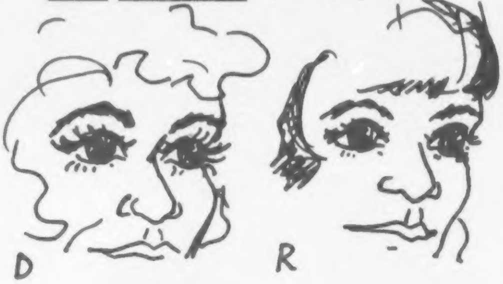
Dark Hair



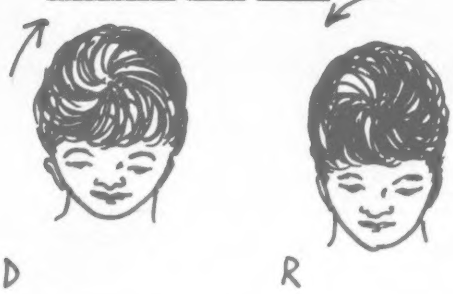
Widows Peak



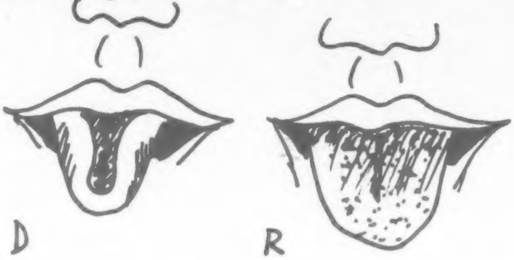
Long Eyelashes 3/8" or more



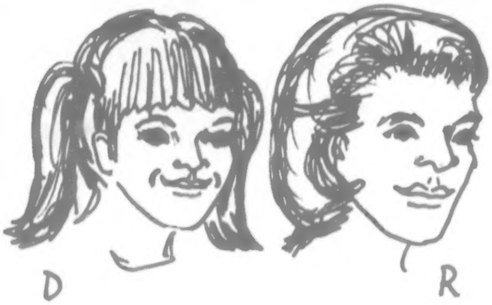
Clockwise Hair Whorl



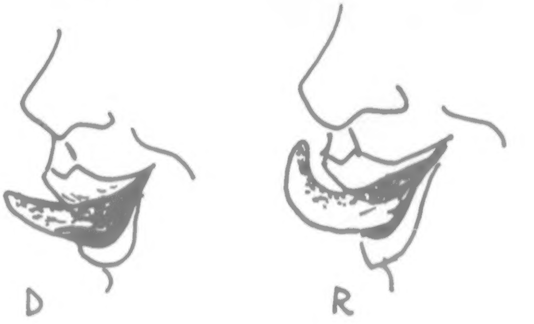
Tongue Rolling - the ability to hold your tongue in a U shape



Dimples



Tongue Folding - the ability to bend the tip back sharply without touching the teeth



Level 7 Unit 2 Life Systems

Chapter 10 Inheritance

Human Heredity

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teahing Time
T-89	10.4	Most Traits are Caused by Many Genes	50 min.
T-89	10.5	Some Traits Go With Sex	100 min. (2 days)
T-90	10.6	Some Diseases Are Inherited	100 min. (2 days)
T-90	10.7	Births Can Be Multiple	100 min. (2 days)

SECTION: 10.4 Human Heredity
Page T-89/S-313 Most Traits Are Caused By Many Genes (50 min.)

TEACHING SUGGESTIONS:

1. The teacher and students read the section.

2. The class discussed the idea that our physical traits are controlled by groups of genes. This gives the great variation among individuals.

3. The students can also discuss their inherited traits in relation to the traits inherited by their brothers or sisters.

Language Cards/Key Signs
dominant genes
recessive genes
variation
physical traits

****

SECTION: 10.5 Human Heredity
Page T-89/S-315 Some Traits Go With Sex (100 min. - 2 days)

ADVANCE PREPARATION: Materials - See the Teacher's Manual for materials/directions for the experiment.* Collect information about hemophilia and make a transparency of the attached sheet about Queen Victoria and her family. Ask the school nurse or a doctor for the complete test for colorblindness.

*Write the directions for the experiment on a chart.

Language Cards/Key Signs
color blind
the sex chromosomes
a carrier
a sex-linked trait
hemophilia

TEACHING SUGGESTIONS:

Day 1

1. The teacher first tells the students that they will take a test. The teacher asks the students to take out a piece of paper. The teacher then shows the students each picture on the test for colorblindness. The students are to write the numbers on their paper.

2. When the teacher has finished giving the test, the students compare answers.

3. The teacher then tells the students that this is a test for colorblindness.

4. The students then begin reading this section. They should read the information up to the experiment.

5. Then the teacher displays the materials and directions for the experiment. The students read the directions.

6. Working in pairs, the students do the experiment. When they have completed the experiment, they should record and discuss the results.

Day 2

1. The students finish reading the section and/or complete work from the previous day.

2. The students read about the disease hemophilia. The teacher explains more about the disease. The teacher displays the transparency of Queen Victoria's family. The teacher explains how hemophilia was transferred in the family.

3. The students, on paper, write the inherited traits which each member of the Queen's family had for hemophilia.

4. The students should review the materials studied in the past two lessons on sex-linked traits.

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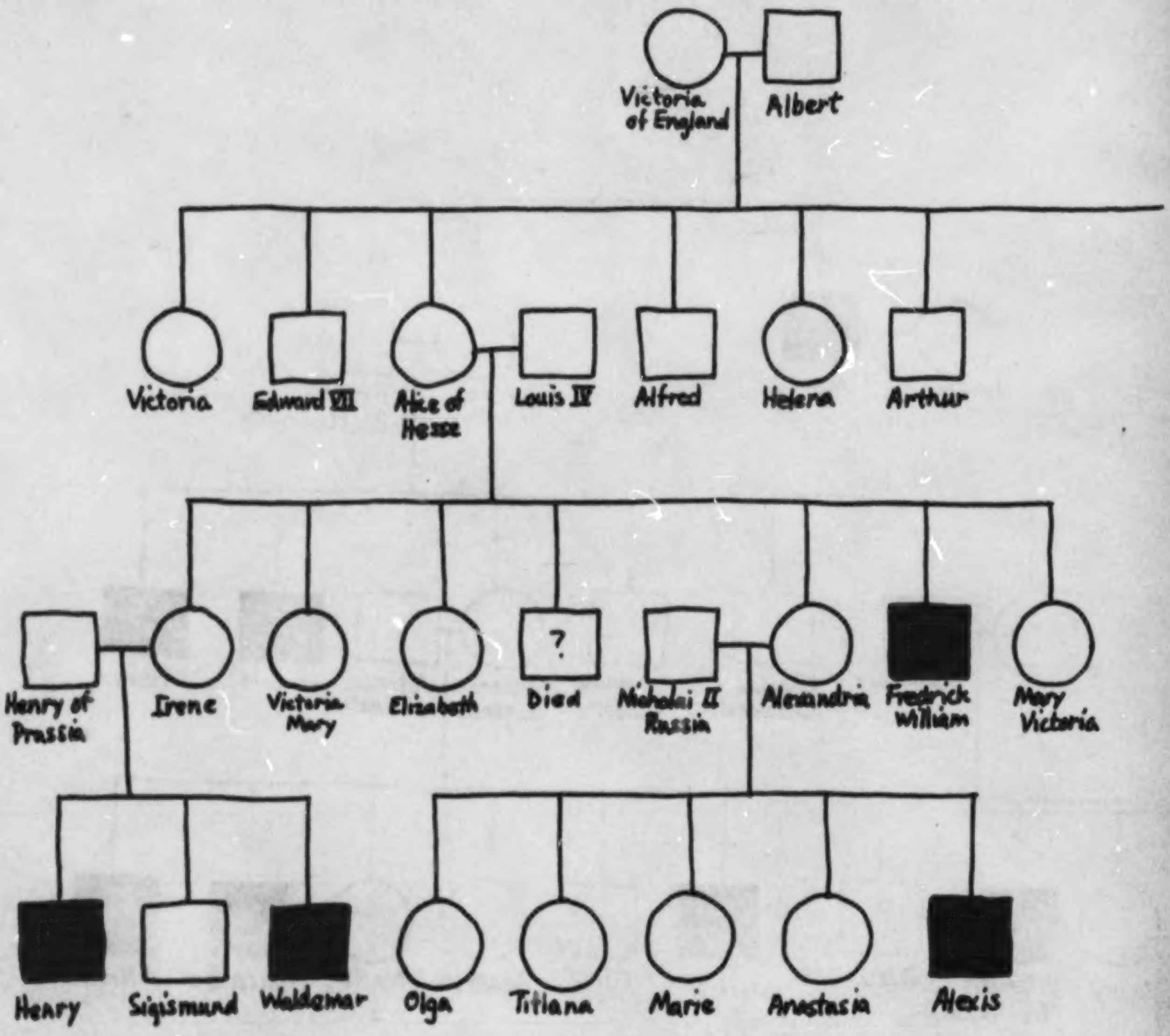
INHERITANCE OF HEMOPHILIA IN DESCENDANTS OF QUEEN VICTORIA OF ENGLAND

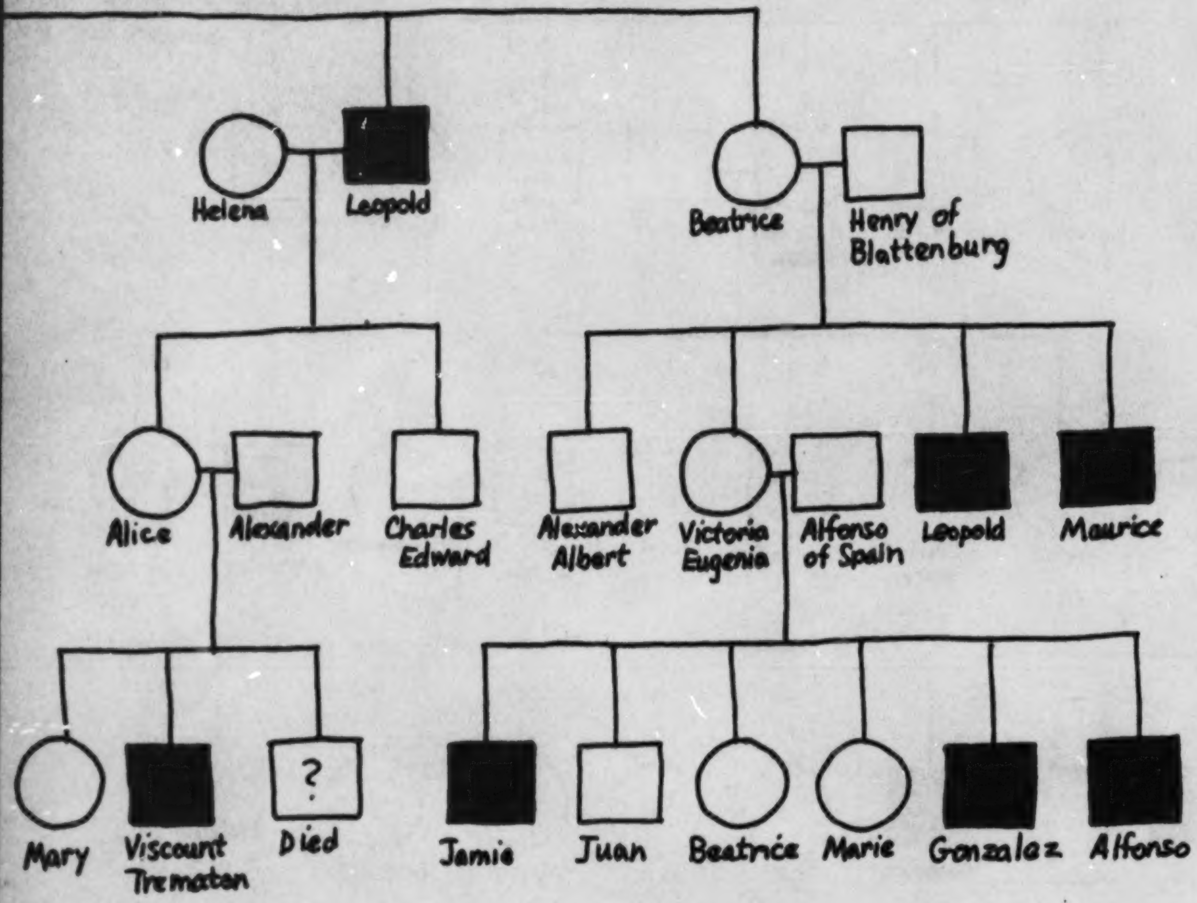
(1) List the mothers who must have carried the trait for hemophilia (heterozygous).


Victoria of England
Albert
Victoria
Edward VII
Alice of Hesse
Louis IV
Alfred
Helena
Arthur
Henry of Prussia
Irene
Victoria Mary
Elizabeth
?
Died
Nicholai II Russia
Alexandria
Fredrick William
Mary Victoria
Henry
Sigismund
Waldemar
Olga
Titiana
Marie
Anastasia
Alexis

☐ Normal Male ○ Normal Female

(2) Consider the marriage of hemophiliac man and a woman homozygous (pure) for normal blood clotting. What percent of their male offspring do you expect to be hemophiliacs?
What percent of their female offspring do you expect to be hemophiliacs?
What percent of the female offspring do you expect to be carriers?

(3) Consider the marriage of a man whose blood clots normally and a woman who is a carrier of hemophilia.
What percent of their male offspring do you expect to be hemophiliacs?
What percent of their female offspring do you expect to be hemophiliacs?
What percent of their offspring should be carriers?


Helena
Leopold
Beatrice
Henry of Blattenburg
Alice
Alexander
Charles Edward
Alexander Albert
Victoria Eugenia
Alfonso of Spain
Leopold
Maurice
Mary
Viscount Trematon
?
Died
Jamie
Juan
Beatrice
Marie
Gonzalez
Alfonso

■ Male hemophiliac

● Female hemophiliac

SECTION: 10.6 Human Heredity

Page T-90/S-317 Some Diseases Are Inherited (100 min. - 2 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for the experiment. Write out the directions on a chart. Also collect additional information about sickle cell anemia. Sources are listed in the Teacher's Manual.

Language Cards/Key Signs
sickle cell anemia

TEACHING SUGGESTIONS:

Day 1

1. The teacher writes the term Sickle Cell Anemia on the board. The teacher asks the students if they have heard of this disease before. The teacher tells the class that this is an inherited disease.
2. The teacher and students read the first part of this section up to the experiment. They discuss the information about sickle cell anemia.
3. The teacher then shows the students additional information about the disease. The class discusses all of the information which the teacher has presented.

Day 2

1. The teacher displays the materials and directions for the experiment.
2. The students read the directions, and working in pairs, do the experiment.
3. The students record the results of the experiment, listing all of the possible combinations of traits. The students can check their answers with Figure 10-15.

* * *

SECTION: 10.7 Human Heredity

Page T-90/S-318 Births Can Be Multiple (100 min. - 2 days)

TEACHING SUGGESTIONS:

Day 1

1. The teacher and students read through the section.
2. The teacher explains the new vocabulary words. The students are asked to explain how multiple births occur.
3. The teacher should include in the discussion information about siamese twins.
4. At the end of the class, the teacher asks the students to explain how twins and triplets occur, by explaining the egg and sperm activity.

Language Cards/Key Signs
a multiple birth
twins
triplets
quadruplets
quintuplets
sextuplets
fraternal twins
identical twins
siamese twins

Day 2

1. The students read the Highlights. The teacher asks the students questions about the information in this section.
2. The students write the answers to the Checkpoints. The teacher can reword the questions if necessary.
3. When the students have completed their answers, they should discuss them with the class.

* * *

Level 7 Unit 2 Life Systems

Chapter 10 Inheritance

Breeding and Environment

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-90	10.8	More Useful Organisms Can Be Developed	50 min.
T-91	10.9	Environment Influences Inherited Traits	200 min. (4 days)

SECTION: 10.8 Breeding and Environment
Page T-90/S-322 More Useful Organisms Can Be Developed (50 min.)

TEACHING SUGGESTIONS:

Language Cards/Key Signs
- an ancestor
- teosinte
- tassels
- kernels
- ears of corn
- breeding
- desirable inherited traits
- selection
- hybrid corssing

1. The teacher begins the lesson by posing a problem. The people wanted to create better corn. They had some corn with small, tough kernels, and plants with corn that had larger ears and softer kernels. What could they do to make a different kind of corn? The class should discuss the possibilities.

2. Then the teacher and students read the beginning of the section which explains the corn problem and the idea of breeding.

3. Then the teacher should pose another problem. A farmer wants his hen to produce a lot of eggs. He has some hens that produce many eggs and other hens that do not. What can the farmer do? The class should again discuss the possibilities.

4. Then the teacher and students should read the part of the section which explains the farmer and his problem. The students should compare their solutions to the problem to what the farmer actually did.

5. The teacher and students should continue to read the rest of the section about the steers.

6. The students (or teacher) should think of other situations where breeding might be necessary to improve the quality of lifespan of an organism.

****

SECTION: 10.9 Breeding and Environment
Page T-91/S-325 Environment Influences Inherited Traits (200 min. - 4 days)

ADVANCE PREPARATION: Materials - Copy page 330 and make one copy for each student.

Language Cards/Key Signs
environment
an ability
a talent
genetics
a bloodhound
a pointer

TEACHING SUGGESTIONS:

Day 1

1. The students and teacher read through the section, discussing the content and the vocabulary. The teacher asks the students to give examples of talents in their family or other families. (If several students are interested, they could set up an experiment like in Figure 10-22.)

Day 2

1. The teacher should read the story 'People Change Plants and Animals' to the students.

2. The class discusses the information in the section.

3. The teacher asks the students to explain how the bloodhound, yellow tea rose and special peachtree were developed.

4. The class discusses the importance of this type of scientific work.

Day 3

1. The students read the Highlights. The teacher asks them questions about the concepts of this section.

2. The students write the answers to the Checkpoints. The teacher rewords the questions if necessary.

3. When the students complete their answers, they should discuss them.

Day 4

1. The teacher passes out the sheet of figures for Skullduggery.

2. The teacher also writes a list of possible answers on the board.

3. The students read the sentences and write in the answers.

4. The students complete the worksheet on the features of the family.

5. The teacher reads the What's Next? section to the students. The class discusses the content of the next chapter.

* * *

Level 7 Unit 3 Ecological Systems

Chapter 11 Communities

A Pond Is a Hub of Life

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
	11.0	Introduction	30 min.
T-93	11.1	What is a Pond?	150 min. (3 days)
T-94	11.2	A Pond Contains Many Organisms	150 min. (3 days)

SECTION: 11.0 A Pond Is a Hub of Life
Does not appear in text Introduction (30 min.)

TEACHING SUGGESTIONS:

1. To begin the new unit and chapter, the teacher reads the introduction to the students changing the language where necessary.

2. The class then discusses the information and also discusses what is pictured on pages 334 and 335.

3. The teacher explains to the class that this unit is about organisms interacting with other organisms. The teacher also explains that this chapter discusses communities/pond communities and explores organisms interaction in this community.

4. At the end of the class, the teacher asks the students if they are near any bodies of fresh water. The students are to bring a gallon of water from one of these places if possible. (NOTE: The water can come from a pond, puddle, stream, lake or reservoir.) If the students cannot supply the water then the teacher should go out and collect it.

****

SECTION: 11.1 A Pond Is a Hub of Life
Page T-93/S-336 What Is a Pond? (150 min. - 3 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for experiment.* The mural should be displayed in the classroom, so that the students can continue working on it. Collect pictures of various bodies of water, mount them on cardboard, and place them on a bulletin board, with labels, near the mural.

Language Cards/Key Signs
a reservoir
a lake
a stream

*Write the directions on a chart.

TEACHING SUGGESTIONS:

Day 1

1. The teacher and students first read the section. The class discusses what a pond is. Also the discussion focuses on other bodies of water. The teacher can refer to the bulletin board when discussing these bodies of water.
2. The teacher displays the materials and directions for the experiment. The students set up the experiment.
3. The students write down their initial observation of the water from different places. These should be kept as a log and can be placed on a bulletin board near the water samples. The students should do this observation each day.

Day 2

1. The students begin the class by observing the water. They write down their observations for this day in their logs.
2. The teacher reviews the bodies of water and their names.
3. The students continue their work on the mural, adding any organisms which they have observed in the pond water sample. NOTE: It is possible to keep the pond water sample and continue to look at it every few days. The organisms will continue to grow and develop.

Day 3

1. The students should read the Highlights section after section 11-2. The teacher asks the students questions about the concept from this section.
2. The students write the answers to Checkpoints. The teacher could reword the questions if necessary.
3. When the students have completed their work, they should discuss their answers with the class.
4. Because this section is short, the students might have extra time at the end of the class. They can continue to observe organisms, observe the pond water, and work on the mural.

****

SECTION: 11.2 A Pond Is a Hub of Life
Page T-94/S-338 A Pond Contains Many Organisms (150 min. - 3 days)

ADVANCE PREPARATION: Materials - Plan a field trip to a nearby pond. See Teacher's Manual for materials/directions for the two experiments. Write the directions for the experiments on chart paper. (NOTE: Take extra water from the pond to do the experiment in 11.1.) Have a large sheet of butcher paper ready for a mural, which students will draw. Students should bring the 'window' made on day 1, paper to write observations on, and bottles to collect samples.

Language Cards/Key Signs
a pond
an organism
(names for plants and animals observed in pond)

Identification Cards
(Labels for mural on pond
(Plants and animals)

1065

TEACHING SUGGESTIONS:

Day 1

1. The teacher explains to the class that they will be studying a pond community and that they will be visiting a pond the next day.

2. The teacher then displays the materials for the first experiment, along with the directions.

3. The students read the directions and label the materials.

4. Each student then makes his/her 'window.'

5. When the students have completed their 'windows' they should discuss what they think they will see on the trip to the pond.

6. ***

Day 2

1. While on the trip, the students should use their 'windows' to observe organisms in the pond. They should write down their observations and draw pictures of organisms which they see. Also, the students should observe the plants in and around the pond. They should also write down descriptions and draw pictures.

2. The students should take samples of the water, mud, etc. that is asked for in the second experiment.

*** At the end of the class, the teacher should display the directions for the second experiment. The students should read the directions so that they will know what samples to get the following day.

Day 3

1. The students should begin by observing the organisms in the pond water which they collected on the previous day.

2. As the students are observing the organisms, they should draw pictures of them.

3. The students should begin making the mural. This activity can be continued over several days when the students are to draw the pond community which they visited. They should include in the drawing any plant and animal life which they observed. The mural could also show the underwater community, and they can include any organisms which they observed under the microscope.

4. Another part of the mural is the labels. The students, by looking in books, encyclopedias, etc. should find the names for the various organisms which they have put on the mural.

5. At the end of class, the students should look at Figure 11-3 and 11-4 and compare these pond environments to the one which they observed.

****

Level 7 Unit 3 Ecological Systems

Chapter 11 Communities

Interactions in Communities

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-95	11.3	Energy Links Organisms	100 min. (2 days)
T-95	11.4	A Pyramid of Food	50 min.
T-96	11.5	Food Chains Form Food Webs	100 min. (2 days)
T-96	11.6	Ponds Connect To Other Environments	50 min.
T-96	11.7	Each Organism Has A Place in a Community	200 min. (4 days)

SECTION: 11.3 Interactions in Communities
Page T-95/S-341 Energy Links Organisms (100 min.-2 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for the experiment. Collect pictures of predators and their prey. (These will be used for a bulletin board.) Draw the organisms from Figure 11-5 on cards that can be placed on the blackboard during the discussion.

Language Cards/Key Signs
a food chain
energy
a producer
a consumer
a first-order consumer
a second-order consumer
a decomposer
a scavenger
a predator
the prey

TEACHING SUGGESTIONS:

Day 1

1. To begin the lesson, the teacher asks the students to list the organisms which they observed in the pond community. The teacher writes the names of the organisms on the board.

2. Then the teacher asks for volunteers to draw pictures of the organisms. The students then draw the pictures.

3. When the students have finished their drawings, the teacher tapes all of the pictures on the board in no particular order.

4. The teacher then asks the students to discuss relationships between the different organisms. As the students begin to discuss the relationship, the teacher should teach the terms predator and prey. The students should then discuss the organisms in terms of these new words.

5. As the students discuss the relationships, the teacher can rearrange the pictures to show the relationships.

6. After most of the organisms have been arranged, the teacher tells the class that these lines of organisms in the predator/prey pattern are in a food chain. The teacher should explain what is meant by a food chain.

7. After class, the food chains should be displayed on a bulletin board. The teacher also asks the students to sort the pictures of organisms into predator/prey groups. These can also be displayed on the bulletin board.

Day 2

1. The teacher and students begin to read the information in this section, starting at the beginning.

2. When the text explains the food chain, the teacher should make reference to the food chains of the previous lesson.

3. During the discussion, the teacher should display the cards with the pictures from Figure 11-5. After all of the chains have been placed on the board, students should be asked to explain the ordering of the organisms.

4. When the class discusses scavengers, the teacher asks the students to make a list of scavengers. The teacher writes this list on the board. (As an outside project, several students could find out more information about scavengers.)

5. At the end of the class, the teacher asks several students to explain the food chains in Figures 11-5 and 11-6.

A bulletin board with food chains and food webs is very helpful.

****

SECTION: 11.4 Interactions in Communities
Page T-95/S-345 A Pyramid of Food (50 min.)

ADVANCE PREPARATION: Materials - Make a transparency/chart of Figure 11-8. Also make drawings of these organisms on cards to make a food chain.

Language Cards/Key Signs
a food pyramid
algae
rotifers
minnows
pickerel

TEACHING SUGGESTIONS:

1. The teacher displays the drawings of the organisms on the board in no particular order.

2. The teacher asks the students to place the organisms in the proper order to form a food chain.

3. The teacher asks the students how much algae a rotifer must eat to live. The students are to think about possible answers as they read the section.

4. The students and teacher read through the section. The teacher explains any new vocabulary in the section.

5. As the students are discussing the pyramid, the teacher places the transparency on the board. As the different organisms/amounts are discussed, the teacher asks the students to write the organism name and amount required, on the transparency.

6. At the end of the lesson, the teacher asks the students to explain the food pyramid. The teacher also asks the students what they know about the food pyramid in which humans are a member. As an outside project, several students could explore the food pyramid of humans.*

*See Diet for a Small Planet

* * *

SECTION: 11.5 Interactions in Communities
Page T-96/S-246 Food Chains Form Food Webs (100 min. - 2 days)

ADVANCE PREPARATION: Materials - Use the drawings of organisms from Figure 11-5. Make drawings of all of the organisms in Figure 11-11. Make extra copies of the drawings to set up the six food chains.
NOTE: The meadow food web has been omitted and the students need not use their books for this section of the book.

Language Cards/Key Signs
a food web
eating interactions

Identification Cards
(Labels for organisms in food webs)

TEACHING SUGGESTIONS:

Day 1

1. The teacher places the cards for the pond food chains on the board in random order.

2. The teacher asks the students to arrange the organisms in food chains.

3. The teacher asks the students if there would be a better way to arrange the cards. (The teacher can point out the repetition of the cards.) The teacher should guide the students into collapsing the food chains where they overlap.

4. When the students have completed the changes, the teacher tells the students that this is called a food web. The class will be looking at other food webs.

Day 2

1. The teacher places the drawings from the forest food chains on the board in random order. The teacher asks the students to arrange the organisms into food chains. The teacher makes any necessary changes.

2. The teacher then asks the students to make a food web by combining the food chains. After this has been completed, the students discuss the relationships between organisms and how the various food chains were related - how one organism is prey to several predators.

* * *

SECTION: 11.6 Interactions in Communities
Page T-96/S-350 Ponds Connect to Other Environments (50 min.)

ADVANCE PREPARATION: Materials - Use the pictures from the pond and forest environments of the previous lesson.

Language Cards/Key Signs
(Labels for organisms in forest and pond)

TEACHING SUGGESTIONS:

1. The drawings from both food webs are displayed on the board.* The teacher asks the students if the two environments are related.
2. The students are to collapse the two food webs into one large food web. Students should be asked to go to the board and make changes in the two webs.
3. The class discusses the overlap between different environments and where organisms go to search for food.
4. This large food web can be displayed on a bulletin board.

*The students arrange the organisms into the food webs discussed during the previous day's lesson.

****

SECTION: 11.7 Interactions in Communities
Page T-96/S-351 Each Organism Has a Place in a Community (200 min.-4 days)

ADVANCE PREPARATION: Materials - Collect pictures of organisms in their niches. Have a map of Africa (large) of transparency.

Language Cards/Key Signs
to help/to harm
a community
a habitat
a niche
a chimpanzee
a gorilla

TEACHING SUGGESTIONS:

Day 1 and Day 2

1. The teacher shows the class several organisms in their habitat. The students discuss the food of the organism, possible enemies, the kind of environment, and the type of shelter used.
2. Then the students and teacher begin to read the section. The teacher explains the new vocabulary words.
3. The students read and discuss all of the information about the pictures in the section.
4. The students read and discuss what is meant by a niche. The teacher shows the students other pictures of organisms. The class discusses the characteristics of each organism's niche.

Day 3

1. The teacher reads the story about Jane Goodall to the class. During the discussion, the teacher displays the map of Africa and discusses where this woman did her observations.
2. At the end of the class, the teacher asks the students questions about the information in the story.

Day 4

1. The students read the Highlights. The teacher asks the students questions about the concepts covered in this section.
2. The students answer the Checkpoints in writing. The teacher can reword the questions if necessary.
3. When the students have completed their work, they should discuss their answers with the class.

****

Level 7 Unit 3 Ecological Systems

Chapter 11 Communities

Changes in Communities

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-97	11.8	Pond Communities Change Through Succession	50 min.
T-97	11.9	Succession Eventually Stops	100 min. (2 days)

SECTION: 11.8 Changes in Communities
Page T-97/S-356 Pond Communities Change Through Succession (50 min.)

ADVANCE PREPARATION: Materials - Collect pictures of glaciers, and collect any information which can be found on succession.
NOTE: When reading the section, the students should not look at Figure 11-19. This will be used in the next lesson.

Language Cards/Key Signs
succession
a glacier
a pit
concentration

TEACHING SUGGESTIONS:

1. The teacher begins the lesson by asking the students to look at the pictures on pages 334 and 335. The teacher asks the students to compare the pictures and give reasons for the differences between them.

2. The teacher then reads the section to the class (or paraphrase it). As the teacher is explaining succession, the teacher is drawing the different things on the board. For example, first the teacher draws a glacier. Then the glacier is erased and a pit is left. Then the pit fills with water, etc. As each new thing is added, the teacher explains what is happening and draws it in the picture on the board.

3. The teacher goes through the entire section this way. After the teacher has explained the succession, then the teacher can ask the students questions about the order of events. Several students could explain parts of the succession process.

****

SECTION: 11.9 Changes in Communities
Page T-97/S-357 Succession Eventually Ends (100 min. - 2 days)

TEACHING SUGGESTIONS:

1. The students turn to page 358, Figure 11-19. The teacher asks several students to explain succession in terms of these pictures. This is to be used as a review of the previous section.

Language Cards/Key Signs
a pioneer community
a climax community
the climate

2. At the end of the review discussion, the teacher asks the students if this process ever stops. The students compare the information to their discussion earlier in the lesson.

3. The teacher and students read the section. The students discuss the information as they go along. They should compare the information to their discussion earlier in the lesson.

4. At the end of the lesson, the teacher asks the students to explain the pictures on page 358, using the new vocabulary of the lesson.

Day 2

1. The students read the Highlights section. The teacher asks them questions about the concepts in this section.

2. The students write the answers to the Checkpoints.

3. When the students have completed their work they should discuss their answers with the class.

4. The Skullduggery section can be omitted. At the end of the class, the teacher reads the What's Next section to the class. They discuss its contents.

****

Level 7 Unit 3 Ecological Systems

Chapter 12 World Ecosystems

Chemical Cycles

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-100	12.4	Gas Exchange (set up)	50 min.
T-100	12.1	Matter Is Recycled	100 min. (2 days)
T-100	12.2	The Carbon and Oxygen Cycles	50 min.
T-100	12.3	The Nitrogen Cycle	50 min.
T-100	12.4	Gas Exchange in a Balanced Aquarium	50 min.
NOTE: Change of order of lessons.			

SECTION: 12.4 Chemical Cycles
Page T-100/S-370 Gas Exchange (set up) (50 min.)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for the aquarium.

Language Cards/Key Signs
an aquarium
an air pump
gravel
a snail

Identification Cards
(Labels for parts of the aquarium)

TEACHING SUGGESTIONS:

1. The teacher displays the materials for making the aquarium.
2. The students label the materials.
3. The teacher and students discuss the steps necessary to set up an aquarium. The teacher writes the steps on the board. The class also discusses the function of each part of the aquarium equipment.
4. The students then set up the aquarium, following the directions on the board.
5. The students will continue with the activity each day while this section is being taught.

* * *

SECTION: 12.1 Chemical Cycles
Page T-100/S-364 Matter Is Recycled (100 min. - 2 days)

ADVANCE PREPARATION: Materials - See Teacher's manual for the experiment and demonstration.* Write directions for the experiment on chart paper. Make a transparency of Figure 12-1 (or use a picture of the water cycle.) Make a ditto of the water cycle. At the bottom of the page write the words- evaporation, condensation, and precipitation.
*Use the directions from the students' text to set up the experiment.

Language Cards/Key Signs
to recycle
matter
hydrogen
oxygen
evaporation
condensation
precipitation
the water cycle

Identification Cards
(Labels for the materials)

TEACHING SUGGESTIONS:

Day 1

1. The teacher begins the lesson by explaining that they will be studying different kinds of cycles. The class should discuss what is meant by a cycle.
2. The teacher then displays the materials for the experiment on page 366, and the directions for the experiment.
3. The students read the directions and label the materials.
4. The students, working in pairs, set up the experiment, do the experiment, and observe the results.
5. When all of the students have completed the experiment, they discuss their observations. (NOTE: One set of materials should be left set up for the next lesson.)*

Day 2

1. The students and teacher begin to read the section about the water cycle.
2. As the section is being read, the teacher places the transparency of the water cycle on the board. The teacher should add to the discussion any vocabulary words not listed in the text.
3. The teacher should do the demonstration about changes in matter where appropriate in the text.
4. When discussing the information about 'dirty' water, the students should relate the experiment of the previous day to the new information.
5. The students should use the words: evaporation, condensation and precipitation when discussing the experiment, showing the location of each phenomena.
6. At the end of class, the teacher passes out the ditto of the water cycle. The teacher asks the students to correctly label the parts of the cycle using the words at the bottom of the page.
7. The students should observe the aquarium.

*The students should place the organisms in the aquarium.

****

SECTION: 12.2 Chemical Cycles
Page T-100/S-366 The Carbon and Oxygen Cycles (50 min.)

ADVANCE PREPARATION: Materials - Make a transparency of Figure 12-3 and 12-4.

NOTE: The aquarium should be ready to seal up during this class.

Language Cards/Key Signs	
producers	consumers
scavengers	decomposers
to exchange	respiration
carbon dioxide	
the carbon cycle	
the oxygen cycle	

TEACHING SUGGESTIONS:

1. The students and teacher read the information in this section.
2. The teacher displays the transparency of the carbon cycle and then the oxygen cycle at the appropriate times.
3. After the students have discussed the two cycles, the teacher asks the students to discuss the cycles in relation to the aquarium.
4. The teacher then asks if these cycles could occur in the aquarium without any outside help. The students discuss the possibilities.
5. The students then seal the aquarium and discuss the possible results.
6. The students will continue to observe the aquarium each day during this chapter. The teacher or a student can write down the observations, keeping a log on the aquarium.

* * *

SECTION: 12.3 Chemical Cycles
Page T-100/S-268 The Nitrogen Cycle (50 min.)

ADVANCE PREPARATION: Materials - Make a transparency of Figure 12-6. If possible, dig up clover plants or other plants which produce nitrogen.

Language Cards/Key Signs
nitrogen
proteins
bacteria
the nitrogen cycle

TEACHING SUGGESTIONS:

1. The teacher and students read the section. During the lesson the teacher displays the transparency of the nitrogen cycle.
2. Also, during the discussion, the teacher displays the plants which produce nitrogen. The students should look at the plants and locate the structures on the roots where nitrogen production occurs.
3. The students should discuss the importance of nitrogen in the soil for growing things and what would happen to plants growing in soil that was nitrogen poor.
4. At the end of the class the teacher asks several students to explain the transparency on the nitrogen cycle.

* * *

SECTION: 12.4 Chemical Cycles
Page T-100/S-370 Gas Exchange in a Balanced Aquarium (50 min.)

TEACHING SUGGESTIONS:

1. The students read the Highlights. The teacher asks the students questions about the information in this section.
2. The students write the answers to the Checkpoints. The teacher can reword the questions if necessary.
3. After the students have completed their answers, they should discuss them with the class.

* * *

Level 7 Unit 3 Ecological Systems

Chapter 12 World Ecosystems

Ecosystems and Climates

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-102	12.5	Organisms Are Parts of Ecosystems	50 min.
T-102	12.6	Climate Influences Ecosystems	10 days (or more)
T-102	12.7	Ecosystems Have Different Soils	50 min.
		Working with Forests and Soils	100 min. (2 days)
		Highlights/Checkpoints	50 min.
		Skullduggery	50 min.

SECTION: 12.5 Ecosystems and Climates
Page T-102/S-371 Organisms Are Parts of Ecosystems (50 min.)

ADVANCE PREPARATION: Materials - Make a transparency of Figure 12-8 from the Teacher's Manual. Collect pictures of natural and man-made ecosystems. Mount each picture on cardboard. Make a title for a bulletin board - ECOSYSTEMS.

Language Cards/Key Signs
an ecosystem
a community
a meadow
an orange grove
a rice paddy
upwelling
an estuary ecosystem

TEACHING SUGGESTIONS:

1. The teacher displays the transparency of Figure 12-8. The teacher asks the students to name the living and non-living things in the picture. The teacher writes the information on the board under the headings LIVING and NON-LIVING. (NOTE: The teacher can help with the names of the organisms with which the students are unfamiliar.)

2. The teacher then writes the word AN ECOSYSTEM above the living and non-living headings/lists. The teacher explains to the class that an ecosystem is made up of non-living things plus living organisms all in a particular location.

3. The students and teacher then begin to read the section.

4. When discussing man-made ecosystems, the teacher displays some of the pictures, and asks the students to identify the man-made ecosystems.

5. The class continues to read the information in this section.

6. After all of the information has been read, the teacher shows the class other pictures of ecosystems. The teacher asks the students to state if the ecosystem is man-made or not and to list the living and non-living elements of the ecosystem.

7. At the end of the class, the students and teacher put the pictures on the bulletin board.

****

SECTION: 12.6 Ecosystems and Climates
Page T-102/S-373 Climate Influences Ecosystems (10 days or more)

ADVANCE PREPARATION: Materials - Collect magazines which have a large variety of organisms from the ecosystems studied in this section. If possible, get movies or filmstrips or study prints for some or all of the ecosystems. Make a chart/transparency of Figures 12-17 and 12-18. Make a large chart of Figure 12-16 but do not color in the areas. Mount this chart on a classroom wall. See Teacher's Manual for materials for demonstration. Art materials for the dioramas.

Language Cards/Key Signs

a deciduous forest
an evergreen forest
the tundra
the tropical rain forest
the temperate grasslands
the African savanna
the desert
the climate
tropical
the Tropic Zone
a polar climate
the Polar Zone
temperate
the Temperate Zone

TEACHING SUGGESTIONS:

Days 1-7

Each day the class studies a different ecosystem. It is possible that the discussions and activities could take longer than one day. Depending on the materials at hand, and varying the activities, the following things could be done.* (It is suggested that only one or two be done for each ecosystem.)

Movies, filmstrips, study prints, looking in books and identifying the organisms pictures in the book, discussing the living and non-living elements of the ecosystem, making a mural of an ecosystem by cutting out pictures of the organisms and drawing in the rest, etc.

As the students study each area, they should look at Figure 12-16 in their books and discuss the locations of the area. This then can be colored in on the large map which has been displayed in the classroom.

Day 8 (or longer)

1. Each student chooses a different ecosystem. Using paper, paints and other materials including a box, the students make a diorama showing the particular ecosystems. When these are completed they can be displayed in the room or in a central location in the school for other students to see.

Day 9

1. The students and teacher continue in the section, reading on page 390 only, up to the second paragraph, second column.

2. The teacher displays the transparencies which show the zones and the class discussed the characteristics of each zone.

3. During the discussion, the students can refer to the large map of ecosystems and discuss how the ecosystems relate to the climatic zones.

Day 10

1. The students and teacher should begin to read at the third paragraph, second column, page 390.

2. During the reading, the teacher does the demonstration as listed in the Teacher's manual.

3. The students and teacher should continue to read to the end of the section. Special emphasis should be placed on why organisms grow in one ecosystem and not in another.

*In addition to reading in the book, discussing the elements of the system, and naming the organisms pictured

* * *

SECTION: 12.7 Ecosystems and Climates
Page T-102/S-392 Ecosystems Have Different Soils (50 min.)

ADVANCE PREPARATION: Materials - Find or put together different types of soil - sandy, humus. If possible, ask someone from a local agricultural center to come and talk to the class about soils. If some students are interested, they could try growing plants in differrent types of soil. Make a transparency of Figure 12-22. Make a ditto of Figure 12-23, making one copy for each student. Also make an answer key for the puzzle.

Language Cards/Key Signs
humus
a forestry technician
a soil conservationist

TEACHING SUGGESTIONS:

1. The teacher first displays the different types of soils. The class compares and contrasts the soils and discusses the possibilities or organisms living in them and which areas might have this type of soil.

2. The students and teacher then read the section, discussing the information about types of soil. During the discussion, the teacher displays the transparency of Figure 12-22.

3. The class then discusses the location of the different soil types and the possible organisms in these areas. The students should compare this map to the large map on ecosystems.

Day 2 and 3

1. The students and teacher read Working With Forests and Soils.

2. The teacher may need to read the information to the students or paraphrase the text.

3. On the second day, a visitor who works in the area of agriculture should some to the class. The visitor should discuss the different types of soil, the importance of soil conservation and what types of conservation are done in your particular area.

Day 4

1. The students read the Highlights. The teacher asks the students questions about the concepts in this section.

2. The students write the answers to the Checkpoints. (OMIT question #1.)

3. When the students have completed their work, the should discuss their answers with the class.

Day 5

1. The teacher passes out the form the Skullduggery. The teacher also writes a list of possible answers on the board, including some words which are not in the puzzle.

2. The students then work individually or in pairs to complete the puzzle.

3. When the students have completed the puzzle, they should check their answers with the answer key.

4. The teacher then reads the What's Next section to the students.

5. The class discusses the information which will be covered in the next chapter.

****

Level 7 Unit 3 Ecological Systems

Chapter 13 Populations

Populations in Communities

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-106	13.1	(omit)	
	13.0	Introduction	45 min.
T-107	13.2	How Can A Population Change?	50 min.
T-108	13.3	Population Growth is Limited	50 min.
T-108	13.4	Populations Affect Each Other	150 min. (3 days)

SECTION: 13.0 Populations in Communities
Does not appear in text Introduction (45 min.)

ADVANCE PREPARATION: Materials - Make cut outs of huts with grass roofs, cats, lizards, rats, flies, mosquitoes, wasps, catepillars, etc.

Language Cards/Key Signs
an insecticide
a population

TEACHING SUGGESTIONS:

(NOTE: This lesson should be done as a story, told by the teacher - the books need not be used.)

1. Using the cutouts and taping them to the board, the teacher explains the island environment. The relationships of all the organisms should be discussed before discussing the effect of the poison.

2. The teacher then explains what happened when poisons were dropped, and again discuss the relationships and how they were affected by the insecticides.

3. The teacher then explains that this was a real place and asks the students to solve the problem.

4. The class discusses possibilities and then the teacher explains what was actually done.

5. At the end of the lesson, the teacher writes POPULATION on the board and asks the students to define the word and discuss it in terms of the insecticide problem.

****

SECTION: 13.2 Populations in Communities
Page T-107/S-403 How Can a Population Change? (50 min.)

TEACHING SUGGESTIONS:

Language Cards/Key Signs
increasing population
decreasing population

1. The teacher begins by reviewing the term population. The teacher asks students to name different populations.

2. The teacher asks the students if a population can increase or decrease in size.

3. After the students respond, the teacher writes Increasing Population and Decreasing Population.

4. The teacher then asks the students to discuss reasons for increase/decrease in a particular population. The teacher should use the previous day's lesson as a reference. The four essential factors of change are: birth, death, movement into, movement out of. The teacher should be sure these factors are mentioned. Each factor should be noted on the board under the appropriate column.

NOTE: The book should not be used for this lesson.

****

SECTION: 13.1 Populations in Communities
Page T-108/S-404 Population Growth Is Limited (50 min.)

ADVANCE PREPARATION: The graphs (13-3, 13-4) about yeast cells should not be used. Use of the book is optional.

Language Cards/Key Signs
a limiting factor

TEACHING SUGGESTIONS:

1. The teacher begins by reviewing reasons for increase/decrease in populations.

2. The teacher asks the students if a particular population - possibly the rat population in the Introduction - would increase indefinitely.

3. Then the teacher asks what things could limit population growth. The teacher writes Limiting Factors on the board and explains the meaning of this term.

4. The students, through discussion, list limiting factors.

5. The teacher should be sure the discussion includes such factors as: food, disease, predators, and space.

****

SECTION: 13.4 Populations in Communities
Page T-108/S-406 Populations Effect Each Other (150 min. - 3 days)

ADVANCE PREPARATION: Materials - Collect information about wildlife conservation. Display the materials in the classroom. National Wildlife Federation is an excellent source of information.

Language Cards/Key Signs
populations effect each other
a wildlife manager

TEACHING SUGGESTIONS:

Day 1

1. The teacher and students should read through this section, referring to graphs when necessary.

2. When discussing the rabbit/lynx populations, the teacher should first explain the relationship and then ask several students to explain the changes in populations.

Day 2 - Working to Protect Wildlife

1. The teacher reads the section to the students.

2. The class discusses the meaning of wildlife protection.

3. The students should make a list of various jobs of a wildlife manager. The teacher writes these on the board.

4. The class could discuss what they can do to help wildlife: feeding birds, squirrels, caring for baby birds, not bothering naimals in the wild, etc.

Day 3

1. The students should read the Highlights (omit paragraph two).

2. The students then answer questions 1, 3 and 4 of Checkpoints.

3. When the students have completed their answers, they should discuss them with the class.

****

Level 7 Unit 3 Ecological Systems

Chapter 13 Populations

The Human Population

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-108	13.5	Are There Limits On Human Population Growth?	100 min. (2 days)
T-109	13.6	What Will Happen to the Human Population?	120 min. (2½ days)

SECTION: 13.1 The Human Population
Page T-108/S-410 Are There Limits on Human Population Growth?
(100 min. - 2 days)

Language Cards/Key Signs
a census

ADVANCE PREPARATION: Materials - If possible, get information from the 1980 census, and one other census.

TEACHING SUGGESTIONS:

Day 1 and Day 2

1. The teacher and students read through the entire section, discussing each concept.

2. After reading the section, the students should discuss/compare limiting factors now and 100 years ago. These could be written on the board under the dates; 1880, 1980.

3. While looking at Figure 13-9, the students should discuss the results of the limiting factors on population numbers.

4. Using the information from the 1980 census and others, the teacher should give the students the statistics. The class should compare the results of the census and possible reasons for the changes. (The teacher should include in the discussion more aspects of the census than just numbers of the entire population.)

****

SECTION: 13.6 The Human Population
Page T-109/S-413 What Will Happen to the Human Population?
(120 min. - 2½days)

TEACHING SUGGESTIONS:

Day 1

1. To begin the lesson, the teacher asks the students to discuss what will happen to our population on earth as the human population increases.

2. After discussing the possibilities, the teacher and students then read the section.

Day 2 and Day 3

1. The students read the Highlights section.
2. The students answer the Checkpoints.
3. After completing their answers, the students should discuss them with the class.
4. Skullduggery can be used to review chapter information.
5. The teacher reads the What/s Next section to the class. They discuss the information.

****

Level 7 Unit 3 Ecological Systems

Chapter 14 Natural Selection

Change and Survival

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-112	14.1	Organisms Can Live With a Little Change	100 min. (2 days)
T-112	14.2	Individual Differences Help Species Survive	100 min. (2 days)
T-112	14.3	Environmental Change	50 min.
T-113	14.4	New Species Sometimes Appear	150 min. (3 days)

SECTION: 14.1 Change and Survival
Page T-112/S-420 Organisms Can Live With a Little Change (100 min. - 2 days)

TEACHING SUGGESTIONS:

Language Cards/Key Signs
an ecosystem
to survive
a predator

1. The teacher should read and explain the section to the students.

2. The teacher should place emphasis on Figure 14-1, discussing each picture with the class.

3. The important points which should be emphasized by the teacher are:
   - environments change
   - organisms must be able to adjust to change in order to survive.

4. The teacher should place special emphasis throughout the lesson on survival as the factor which heads all other factors.

NOTE: This section should be used to introduce the chapter. The actual chapter introduction should be omitted.

****

SECTION: 14.2 Change and Survival
Page T-112/S-422 Individual Differences Help Species Survive
(100 min. - 2 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for the experiment on page 422. If possible, use stamp pads and paper. Write directions on chart or transparency. (NOTE: The experiment on page 424-425 has been omitted.)

Identification Cards
(Labels for materials in experiment)

TEACHING SUGGESTIONS:

Day 1

1. The students read the first paragraph of the section and discuss the information.
2. The teacher displays the materials and directions for the experiment.
3. The students label the materials and read the directions.
4. Materials are passed out by the teacher. The students complete the experiment.
5. The students compare their work to that of their classmates and to Figure 14-2.

Day 2

1. The teacher and students read the section (omitting the second experiment).
2. The students should discuss the importance of sexual reproduction in producing a variety of organisms.

Variety Helps Species Survive

To the Teacher:

This lab activity will help to reinforce the concept that sexual reproduction produces variety in offspring.

- Pipe cleaners will be used to represent chromosomes of the parents.
- Using four different colors of pipe cleaners will make more combinations possible in the offspring than two.
- If you assign colors for the male and female chromosomes rather than allowing the students to select them at random, the following discussion will be easier to conduct.

R = Red   (RB) ♂   (YG) ♀   Y = Yellow
B = Blue   G = Green

Help your students manipulate the pipe cleaners. When the students have completed manipulations and have answered the questions, discuss the questions in the activity with the class.

Main Concepts:

1. Because of sexual reproduction, offspring are not exactly like the parents.
2. Sexual reproduction promotes variety.

See student activity on the next page.

* * *

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VARIETY HELPS SPECIES SURVIVE

The pipe cleaners will represent chromosomes in the cells of a mouse. Chromosomes control the characteristics an organism has, such as skin color. Assume that the different colored pipe cleaners determine the fur color of the mice.

Materials : -pieces of pipe cleaners (4 colors)
-colored pencils (same colors as pipe cleaners)
-draw diagram 1 on a separate sheet of paper

Procedure:

1. Select two pipe cleaners and place them in the circle marked male mouse. Draw the pipe cleaners in the circle with your colored pencils.

2. Place the other two pipe cleaners in the circle marked female mouse. Draw the pipe cleaners in the circle with your colored pencils.

   Assume that the fur color of the mice is determined by the chromosomes they have.
   Do the male and female mouse have the same fur color?____________________
   Why or why not?____

3. When sex cells are formed, each sex cell contains only one-half as many chromosomes as the body cells of an organism. Place one pipe cleaner from the circle marked male in the sperm. Place one pipe cleaner in the circle marked female in the egg. Draw these chromosomes using your colored pencils.

4. When a sperm and an egg join, fertilization occurs. Move the pipe cleaners from the sperm and the pipe cleaners from the egg into the zygote. Draw the chromosomes with your colored pencils.

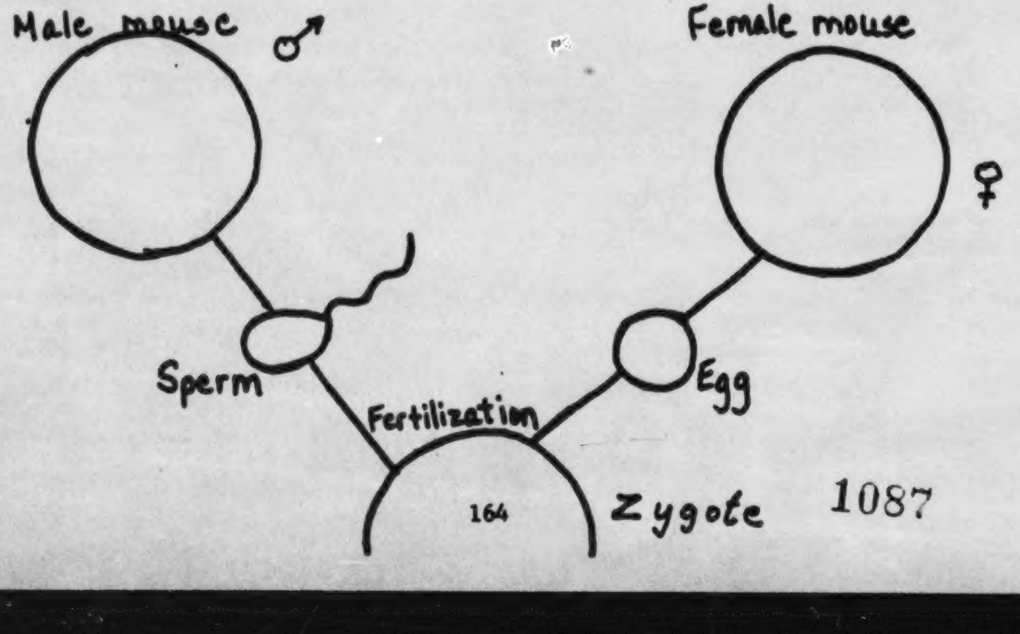
   Will the new mouse have the same color fur as its parents?_______________
   What reason do you have for your answer?________________________

5. In how many ways can the chromosomes of the parent mice be joined in the zygote?

   ____

   Remember, each parent must contribute one-half of the chromosomes in the zygote. Draw all the possible combinations that can be produced bt the two parents using your colored pencils.

Diagram 1



SECTION: 14.3 Change and Survival

Page T-112/S-427 Environmental Change (50 min.)

ADVANCE PREPARATION: Materials - Make cutouts of moths of white and black. Have backgrounds of white (light green) and black. Make backgrounds look like tree trunks by cutting them into the shape of trees and adding markings. They should be large enough to go on the blackboard - moths large enough to be seen by the class.

Language Cards/Key Signs
- adaptation
- a peppered moth
- coal
- natural selection

TEACHING SUGGESTIONS:

1. Before class the teacher should take the different colored tress to the board.

2. The teacher should then tell the story of the peppered moth (p. 427). At the beginning the teacher should put a light and dark moth on the light tree and ask which a bird might see. Then the teacher should explain that was why the moths were light. The light ones survived to reproduce and the dark ones did not.

3. The teacher should then describe how the environment changed. The moth cutouts should then be moved to the black tree. The same questions should be asked by the teacher.

4. At the end of this, the teacher should explain that the changes are called adaptations. The teacher should ask the students to identify adaptations of other organisms. Have students perform Mice and Selection on following page.

* * *

SECTION: 14.4 Change and Survival

Page T-113/S-428 New Species Sometimes Appear (150 min. - 3 days)

ADVANCE PREPARATION: Materials - Make an outline transparency of North America.

Language Cards/Key Signs
- a species
- natural selection
- a natural barrier
- a mutation

TEACHING SUGGESTIONS:

Day 1 and Day 2

1. The teacher reads the section to the students. The class discusses each concept as they occur in the section.

2. During the explanation of the flicker, the teacher can use the transparency of North America.

3. In the discussion on mutations, the teacher should emphasize the concept that harmless and helpful mutations will be continued. Harmful mutations (the offspring) do not usually live to reproduce.

Day 3

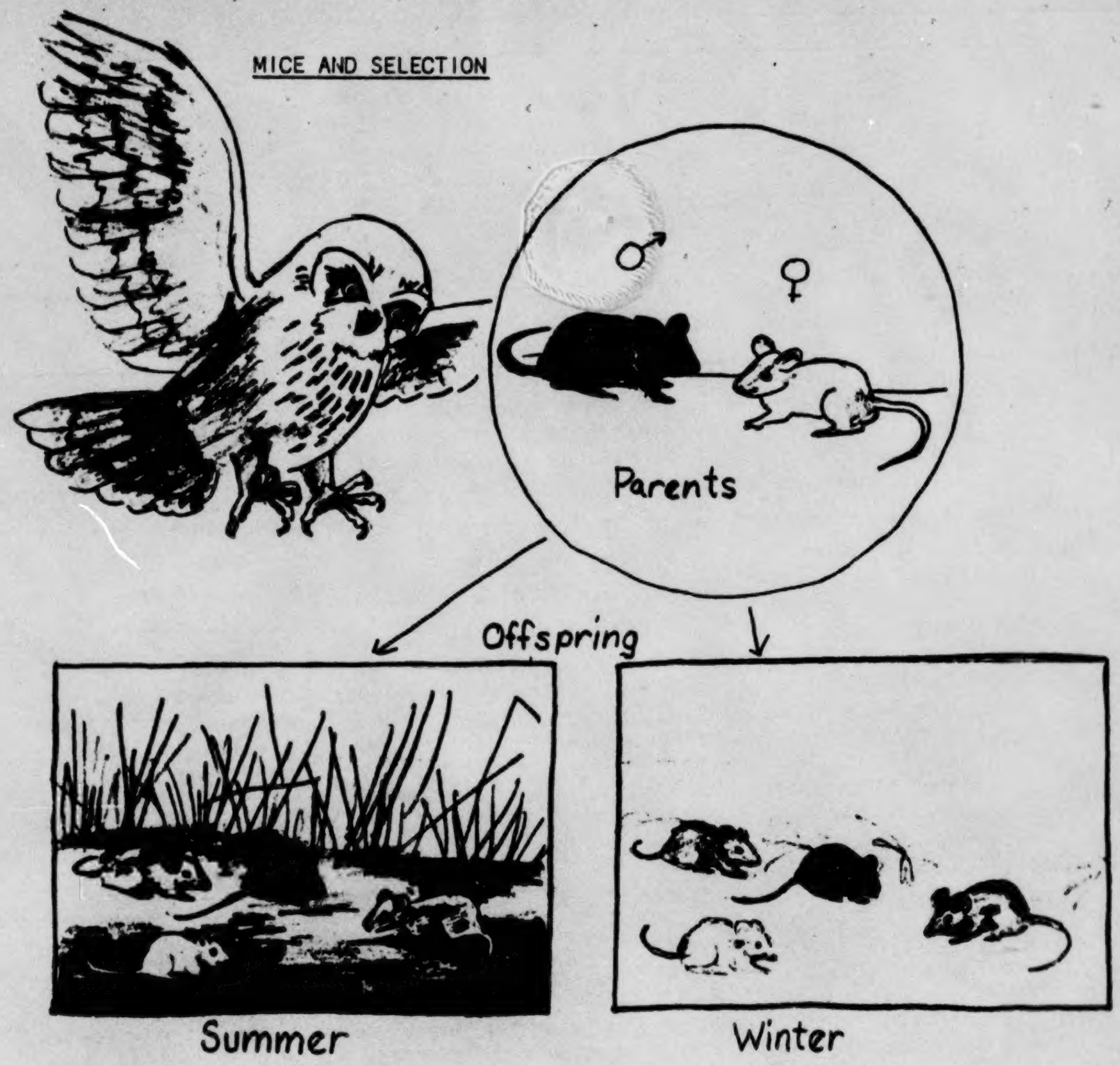
1. The students should read the Highlights. The teacher questions the students on each concept.

2. The students write their answers to Checkpoints. The teacher can reword the questions if necessary.

3. After the students have completed their answers, they should discuss them with the class.

* * *

MICE AND SELECTION



The pictures above illustrate the biological process of Natural Selection.

What color mouse would probably be captured the easiest in summer ? Why?

What color mouse would probably be captured the easiest in winter? Why?

What color will most future mice offspring probably be? Why?

In your own words explain the biological process of Natural Selection. Can you think of your own example of the biological process of Natural Selection?

Level 7 Unit 3 Ecological Systems

Chapter 14 Natural Selection

Dinosaurs Were Winners and Losers

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-113	14.5	Organisms Can Become Fossils	200 min. (4 days)
T-114	14.6	Ancient Ecosystems Include Dinosaurs	100 min. (2 days)
T-115	14.7	Dinosaurs were Losers in the End	150 min. (3 days)

SECTION: 14.5 Dinosaurs Were Winners and Losers
Page T-113/S-432 Organisms Can Become Fossils (200 min. - 4 days)

ADVANCE PREPARATION: Materials - Find a place to collect fossils, or visit a fossil exhibit at a museum or university. See Teacher's Manual for materials/directions for experiment. Write the directions for the experiment on chart paper/transparency. Collect pictures of fossils and books/information about fossils and areas in which they have been discovered. Make a display of the information.

Language Cards/Key Signs
a fossil
preserved
a cast
a mold
petrified

Identification Cards
(Labels for materials in experiment)

TEACHING SUGGESTIONS:

Day 1

1. The class should go fossil hunting, or visit a museum which has fossils.
2. The main points of discussion should be the age of fossils, possible ideas on how they were formed, how they have been discovered, and what organisms they represent (and if the descendants of these organisms are still on the earth today).

Day 2

1. The teacher displays the materials for the experiment and the directions.
2. The students label the materials and read the directions.
3. Working in pairs, the students complete the fossil-making experiment.
4. After the students have completed their work, they should discuss what they have done, and how it related to fossils which they saw the previous day.
5. The students should look at Figure 14-13 and discuss the picture in relation to their experiment.

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Day 3

1. The teacher and students read all of the information in the section.

2. The class discusses each new word and concept.

3. They discuss each figure, and describe the fossils which they see.

4. The students relate the information in this section to that which is shown in the fossil display.

****

SECTION: 14.6 Dinosaurs Were Winners and Losers
Page T-114/S-436 Ancient Ecosystems Include Dinosaurs (100 min. - 2 days)

Language Cards/Key Signs
a dinosaur

ADVANCE PREPARATION: Materials - Collect information, books, pictures of dinosaurs. Set up a display next to fossil display. Tape a long piece of butcher paper to one wall. Write the names of the dinosaurs mentioned in the text (in large letters) on the paper, evenly spaced. (The students will make a mural with this.)

TEACHING SUGGESTIONS:

Day 1

1. The teacher begins the lesson by allowing the students to look through the display on dinosaurs. The class can discuss the information/pictures presented and hypothesize about life during that era.

2. The class then reads through a part of the section. (The section can be completed on the following day.)

3. At the end of class, the teacher explains that they will be making a mural showing the various dinosaurs. The class looks at the various names and hypothesizes about what the dinosaurs might look like.

Day 2

1. The teacher and students continue to read in the section, including a review of the previous day's reading.

2. After reading about all of the different dinosaurs, the students discuss what they looked like, where they lived and what they ate.

3. The students then each choose one dinosaur to draw on the mural. The drawing should include the dinosaurs habitat.

4. The students begin work on the mural. The work could be completed during subsequent classes or during the students' free time.

****

SECTION: 14.7 Dinosaurs Were Winners and Losers
Page T-115/S-440 Dinosaurs Were Losers in the End (150 min. - 3 days)

TEACHING SUGGESTIONS:

Language Cards/Key Signs
extinct
prehistoric

Day 1

1. The students and teacher read the section.
2. After completing the section, the class lists the characteristics of the two periods of dinosaurs.
3. The students can add other dinosaurs to the mural. They should note whether the dinosaur lived during the first or second period.

Day 2

1. The teacher reads "Walk Through Time" to the class.
2. The class discusses the information about each habitat and the organisms which have survived.

Day 3

1. The students read the Highlights. The teacher asks the students questions about each concept from this section.
2. The students write answers to the Checkpoints. The teacher can reword the questions if necessary.
3. After the students have completed their answers, they should discuss them with the class.
4. The students and teacher read "What's Next" and discuss the information.
   NOTE: Skullduggery has been omitted.

* * *

Level 7 Unit 3 Ecological Systems

Chapter 15 Fitness and Health

Keeping the Systems Healthy

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
	15.0	Introduction	45 min.
T-118	15.1	Exercise Strengthens Muscles	50 min.
T-118	15.2	Be Good to Your Heart	150 min. (3 days)
T-119	15.3	Proper Eating Provides Necessary Materials	100 min. (2 days)
T-119	15.4	The Body Needs Sleep	90 min. (2 days)

SECTION: 15.0 Keeping the Systems Healthy
Does not appear in text Introduction (45 min.)

ADVANCE PREPARATION: Materials - Bring a Frisbee or ball to class.

TEACHING SUGGESTIONS:

NOTE: The picture on pages 446-447 can be used. The teacher should explain the material without reading from the book.

1. The teacher asks two students to stand up and throw a ball or Frisbee back and forth.

2. The teacher asks the students to list the events that occur in the body to allow a person to throw and catch the object.

3. The students look at pages 446-447 and the teacher explains the internal events occuring in these two girls.

4. The teacher writes the word ecosystem on the board. The class discusses the body as an ecosystem.

5. The teacher can explain what information will be in the chapter.

****

SECTION: 15.1 Keeping the Systems Healthy
Page T-118/S-448 Exercise Strengthens Muscles (50 min.)

ADVANCE PREPARATION: Materials - Make a display of books on exercise and physical fitness.

Language Cards/Key Signs
a fit body
exercise
vertebrae
the abdominal area

TEACHING SUGGESTIONS:

1. The teacher asks the students to do jumping jacks, sit ups, and to run in place.

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2. The teacher asks the students why exercise is important.

3. The teacher and students read and discuss the section.

4. After reading about the back, the teacher again asks the students why exercise is important to the body.

****

SECTION: 15.2 Keeping the Systems Healthy
Page T-118/S-449 Be Good to Your Heart (150 min. - 3 days)

ADVANCE PREPARATION: Materials - Get additional information on the heart and heart disease from your local chapter of the Heart Association. The World Book Encyclopedia has excellent pictures on heart disease. Make a transparency/chart of attached picture of the heart. Ask your P.E. instructor to visit the class and discuss exercise programs for the students.

Language Cards/Key Signs
a heart attack
hardening of the arteries
a blood clot

TEACHING SUGGESTIONS:

Day 1

1. The teacher and students read the section.

2. The teacher uses any visuals available to discuss heart attacks and hardening of the arteries.

3. At the end of the class, the teacher asks the students to explain why exercise is good for the heart and to list possible heart problems.

Day 2

1. Using the materials from the Heart Association, the teacher explains, in detail, about heart attacks - symptoms, death rate in U.S., and prevention.

2. The teacher also shares with the class any other appropriate information about the heart.

Day 3

1. The P.E. teacher comes to class to discuss an exercise program for the students.

2. The P.E. teacher lists the exercises and which part of the body is affected.

3. The P.E. teacher demonstrates the exercises and the students practice them.

4. The class discusses the necessity of exercise to the physical well-being of the human body.

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SECTION: 15.3 Keeping the Systems Healthy
Page T-119/S-451 Proper Eating Provides Necessary Materials
(100 min. - 2 days)

ADVANCE PREPARATION: Materials - Have the students (along with yourself) collect labels from food packages, which list ingredients. Have large sheets of white paper, markers, and glue for Day 1.

Language Cards/Key Signs
nutrition
a balanced diet
artificial
ingredients

TEACHING SUGGESTIONS:

Day 1

1. The students should bring their labels to class.
2. First, as a group, the class looks at the labels. The teacher reads some of the ingredients on the label.
3. The teacher tells the students that those items listed first are in the greatest quantity in the food.
4. The teacher passes out the white paper, markers and glue to the students.
5. The teacher instructs the students to glue the label to the top of the page. Then the students are to write the first four or five ingredients on the sheet of paper (in large print). These sheets are then put up on a bulletin board or wall, and will be used during Day 2's lesson.

Day 2

1. The teacher has the students refer back to section 5-6 to discuss a balanced diet.
2. The students list the elements of a balanced diet. The teacher writes these on the board.
3. The teacher and students then read the section (15-3) and discuss the need for a balanced diet.
4. The students evaluate the foods on their charts and discuss the importance of such foods in a balanced diet.

* * *

SECTION: 15.4 Keeping the Systems Healthy
Page T-119/S-452 The Body Needs Sleep (90 min. - 2 days)

TEACHING SUGGESTIONS:

Day 1

1. The teacher and students read the section.
2. The teacher explains the sleep cycle.
3. The teacher asks the students what happens to the body during sleep and what happens during REM sleep.

Day 2

1. The students read the Highlights. The teacher asks the students questions about the concepts covered in this section.

2. The students write the answers to the Checkpoints.

3. When the students have completed their answers, they should discuss them with the class.

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Level 7 Unit 3 Ecological Systems

Chapter 15 Fitness and Health

Interacting With the Environment

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-119	15.5	Skin is the First Line of Defense	150 min. (3 days)
T-120	15.6	The Mouth Contains More Than You Think	150 min. (3 days)
T-120	15.7	There is Life In and On People	50 min.
T-121	15.8	Cuts and Scratches Can Be Dangerous	100 min. (2 days)
T-121	15.9	Infectious Diseases Can Be Dangerous	100 min. (2 days)
T-122	15.10	Some Diseases Can Be Prevented or Cured	200 min. (4 days)

SECTION: 15.5 Interacting With the Environment
Page T-119/S-453 Skin is the First Line of Defense (150 min. - 3 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for experiment. Write directions for experiment on chart/transparency. Find or make a large chart/transparency of Figure 15-5 (make separate labels). Also make a ditto with a copy for each student. Write labels for picture at bottom of ditto. Find pictures of acne and how a blemish develops.

Language Cards/Key Signs
a pore
blood vessel
sweat
acne
the epidermis
the dermis
sensory neuron
oil gland
sweat gland

Identification Cards
(Labels for picture of skin)
(Labels for experiment)

TEACHING SUGGESTIONS:

Day 1

1. The teacher places the materials for the experiment on a table in front of the class. The directions are put on the board.

2. The students label the materials and read the directions. (NOTE: No connection between skin and the experiment should be made at the beginning of the experiment.)

3. The students, working in pairs, follow the directions, recording the temperatures on paper.

4. When the students have completed the experiment, they should discuss what they have found (only relating to the experiment itself).

5. The teacher and students then read the first three paragraphs of the section. The teacher asks the students to apply the experiment results to the information on skin.

Day 2 and Day 3

1. The teacher puts up the picture of Figure 15-5 (without labels) to use during the two days.

2. The teacher explains the information in this section to the students. The students do not need to read the section.

3. Day 2 - The teacher explains about the skin's structure, and the function of each part. As each layer is discussed, a student is asked to place the appropriate label on the picture.

4. At the end of class, the students are asked to explain the function of each layer and part.

5. Day 3 - The teacher asks the students to label the large chart and to discuss the function of each part.

6. The teacher then goes on to explain about acne. The teacher shows pictures or draws pictures of how a pimple forms.

7. Students should discuss the proper way to care for skin.

8. At the end of the class, the teacher passes out the ditto. The students are to label the picture of skin.

****

SECTION: 15.6 Interacting With the Environment
Page T-120/S-456 The Mouth Contains More Than You Think (150 min. - 3 days)

ADVANCE PREPARATION: Materials - Buy toothbrushes, toothpaste, floss for each student. Find models of teeth. Ask the school nurse for information on dental hygiene. Have a small mirror for each student. Make a transparency of Figure 15-7. Find or draw a ditto of a typical tooth and another showing all of the teeth, with labels for types of teeth at the bottom of the page.*

*Set up a display on Dental Hygiene with all of the materials you collect. The American Dental Association sells many items to use when discussing oral hygiene.

Language Cards/Key Signs
bacteria
dental floss
a cavity
a molar
a dentist
an incisor
enamel
a premolar
dentine
a canine
pulp
plaque
tartar

Identification Cards
(Labels for pictures of teeth)

TEACHING SUGGESTIONS:

Day 1 and Day 2

1. The teacher has students sit near the display on dental hygiene.

2. The students and teacher read through the section, referring to models, pictures, transparencies where appropriate.

3. The class reads up to the second full paragraph on page 458, column 1.

4. During the discussion, the teacher passes out the mirrors. Students look at their own teeth with the mirrors.

5. At the end of the second day, the teacher passes out the dittos and asks the students to match the label to the part.

Day 3

1. The teacher shows the transparency of Figure 15-7. The teacher asks the students to explain the function of each part of the tooth, to name the teeth, and to explain how a cavity is formed.

2. The students and teacher read the last two paragraphs on page 458, column 1, and discuss dental hygiene.

3. Using a model of the teeth, the teacher shows the students the proper way to floss and brush.

4. The teacher then asks the students to demonstrate flossing and brushing on the model.

5. The teacher gives each students a toothbrush and piece of floss. The students first floss their teeth and then brush their teeth.

6. At the end of the class, the teacher asks the students why dental hygiene is important.

****

SECTION: 15 7 Interacting With the Environment
Page T-120/S-458 There Is Life In and On People (50 min.)

ADVANCE PREPARATION: Materials - Make cut-outs of all parts of Figure 15-8. Make separate labels.

Language Cards/Key Signs
bacteria
protists
viruses
fungi
immunity

Identification Cards
(Labels for Figure 15-8)

TEACHING SUGGESTIONS:

1. The teacher displays the cut-outs from Figure 15-8 (without labels). Put the cut-outs beside the "blood vessel" on the board.

2. The students and teacher read the section, discussing helpful and harmful bacteria, viruses, etc.

3. The teacher uses the cut-outs to explain immunity. First, put up a white blood cell. Show how the germ enters the skin and goes into the blood. Then show how the white cell makes antibodies, and finally, show how the antibodies kill the germ and stay in the blood. Use the labels as each new cut-out is put on the drawing.

4. At the end of the class, remove the cut-outs from the "blood vessel." The teacher asks several students to explain immunity using the cut-outs.

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SECTION: 15.8 Interacting With the Environment
Page T-121/S-459 Cuts and Scratches Can Be Dangerous (100 min. - 2 days)

ADVANCE PREPARATION: Materials - Ask the school nurse to visit the class. Have her bring materials to clean and dress wounds. (NOTE: Ask the students to begin collecting drug (medicine) containers, labels for section 15-11.)

Language Cards/Key Signs
infection
inflammation
tetanus bacteria

TEACHING SUGGESTIONS:

Day 1

1. The nurse should come to class and using the appropriate materials, explain how to clean and dress different wounds (cuts, scrapes, deeper cuts, puncture wounds).

2. The nurse and teacher should discuss why these procedures are done (to kill bacteria).

Day 2

1. The teacher and students read the section, discussing each vocabulary word and concept as it appears.

2. During the discussion on tetanus, the teacher asks the students if they remember getting a tetanus shot. For homework, the teacher asks the students to go home and ask their parents when they had their last booster. Discuss how often and for what reasons a person should have a tetanus shot.

****

SECTION: 15.9 Interacting With the Environment
Page T-121/S-460 Infectious Diseases Can Be Dangerous (100 min. - 2 days)

ADVANCE PREPARATION: Materials - Get additional information, pamphlets, on venereal disease. Set up a display on infectious diseases.

Language Cards/Key Signs
infectious diseases
a fever
strep throat
rheumatic fever
venereal disease
gonorrhea
syphillis

TEACHING SUGGESTIONS:

Day 1

1. The students and teacher read the first part of the section, stopping at the first paragraph, page 461, column 2.

2. The class should discuss the nature of an infectious disease.

Day 2

1. The teacher, using the materials collected, explains the different venereal diseases. The discussion should include how diseases are transferred, the type of bacteria involved, the symptoms and the cures.

2. At the end of class, the teacher asks the students to name the different diseases, and explains the symptoms.

****

Sources of Information: Sexually Transmitted Diseases

Channing L. Bete Co., Inc.
200 State Rd. - pamphlets on VD
South Deerfield, MA 01373

National Institute of Allergy and
Infectious Diseases
Office of Research, Reporting and Public
Response - pamphlets on VD
Bldg. 31, Rm 7A32
9000 Rockville Pike
Bethesda, MD 20014

U.S. Dept. of Health and Human Services
Public Health Service
Center for Disease Control - articles on STD
Atlanta, GA 30333

American Social Health Association
260 Sheridan Ave., #307 - pamphlets on VD
Palo Alto, CA 94306

SECTION: 15.10 Interacting With the Environment
Page T-122/S-462 Some Diseases Can Be Prevented or Cured (200 min. - 4 days)

Language Cards/Key Signs
a vaccine
antibiotic
penicillin
an epidemiologist

Identification Cards
(All diseases listed in Figure 15-12)

ADVANCE PREPARATION: Materials - Make a ditto of Figure 15-12, with a copy for each student. Also make a transparency of Figure 15-12.

TEACHING SUGGESTIONS:

Day 1

1. The teacher and students read the section, discussing the importance of vaccines and antibiotics.

2. The teacher shows the transparency of Figure 15-12. The teacher explains the symptoms and results of each disease in the chart.

3. The teacher gives the students the charts. They are to take these home to be filled out by their parents.

Day 2

1. The teacher and students discuss their charts.

2. The class discusses the necessity of getting the vaccines.

3. The teacher asks the students to explain each disease, and why a vaccine is important.

Day 3

1. The teacher reads the Medical Detectives to the students.

2. The teacher explains the information and vocabulary.

3. The class discusses the need for such people.

Day 4

1. The students read the Highlights. The teacher asks the students questions about each concept.

2. The students write their answers to Checkpoints. The teacher can reword the questions if necessary.

3. After the students have completed their answers, they should discuss them with the class.

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The Body Can Be A Drug Dump

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-123	15.11	What Is A Drug?	100 min. (2 days)
T-123	15.12	Common Drugs Can Be Dangerous	100 min. (2 days)
T-123	15.13	Getting High Can Leave You Low	(5 days)

SECTION: 15.11 The Body Can Be A Drug Dump
Page T-123/S-465 What Is A Drug? (100 min. - 2 days)

ADVANCE PREPARATION: Materials - Collect materials on drugs and set up a display which will be used during the next three sections. Collect as many drug labels/cartons as possible. Ask the students to collect them also (as noted in Section 15.8). See Teacher's Manual for directions/materials for experiment. Make a chart/transparency with directions. Make a ditto for homework asking the students to list drugs in their homes and the purpose of each. Have magazines for Day 2.

Language Cards/Key Signs
a drug
side effects

Identification Cards
(Labels for materials in experiment)

TEACHING SUGGESTIONS:

Day 1

1. The teacher displays the materials for the experiment and the directions. (NOTE: The teacher should not mention the concept of drugs yet. The students should only do the experiment and make their observations.)

2. The students read the directions and label the materials.

3. The teacher passes out the materials, and working in pairs, the students do the experiment.

4. When the students complete the experiment, they should discuss their observations and possible reasons for them.

5. The teacher and students read the section, stopping before the last paragraph (page 466, column 2). They discuss drugs and the concept of side effects.

6. Pass out the ditto on drugs. The students are to fill out the ditto and bring it in for the next day's class.

Day 2

1. First have each student read their homework paper to the class. The teacher writes the names/purposes on the board.

2. The students look through magazines (10 min.) to find adds on drugs.

3. The class looks at the drug containers, paying special attention to the use, purpose and warnings.

4. At the end of class, the teacher asks the students if each drug really does what it says it will do.

* * *

SECTION: 15.12 The Body Can Be A Drug Dump
Page T-123/S-467 Common Drugs Can Be Dangerous (100 min. - 2 days)

ADVANCE PREPARATION: Materials - Get information from the Lung Association about smoking and disease. Alcoholics Anonymous has information on alcoholism. Put a large piece of butcher paper on the wall or bulletin board. Label the chart and fill in information as each new drug is introduced.

Language Cards/Key Signs
caffeine
a stimulant
an alcoholic
drunk
nicotine
cancer
alcohol
a relaxant

TEACHING SUGGESTIONS:

Day 1 and Day 2

1. The teacher and students read and discuss the section.

2. When discussing smoking, the teacher should show the students the materials from the Lung Association.. (They also have movies that can be borrowed.) The class then discusses the pros/cons of smoking.

3. When discussing alcoholism the teacher should use the materials from AA, and also explain the purpose of AA.

4. At the end of the class, the students should fill in the large chart with information from this section.

Chart:

Drug	When do you get drug?	Is it legal or illegal?	What is effect on body?	What are possible side effects?

SECTION: 15.13 The Body Can Be A Drug Dump
Page T-123/S-469 Getting High Can Leave You Low (5 days)

Language Cards/Key Signs
barbituates
amphetamines
narcotics
marijuana
legal/illegal
hallucinogens

ADVANCE PREPARATION: Materials - Same as used in previous lesson. Make copies of Figure 15-17, one for each student. Make a list of possible answers (actual answers plus 5 or 6 other words).

TEACHING SUGGESTIONS:

Day 1

1. The teacher and students read the section (except chart on page 470), discussing each drug.

2. As each drug is discussed, the teacher should show pictures of the pills, plants, etc. from brochures on drugs.

3. At the end of the class, the teacher reviews the drugs and asks the students to explain their effects on the body.

Day 2

1. The class discusses all of the information on page 470.

2. The teacher explains each drug and the effects of the drug on the body.

Day 3

1. Using the chart (p. 470) as a reference, the students put the information on the class chart.

2. When they have completed the information, the teacher asks the students to explain each drug, its effects on the body, and its side effects.

Day 4

1. The students read the Highlights. The teacher asks the students questions about the concepts in this section.

2. The students write the answers to Checkpoints (omit #4, use as discussion only).

3. When the students have completed their answers, they discuss them with the class. They also discuss possible answers to question 4.

Day 5

1. The teacher passes out copies of Figure 15-17 and places the list of possible answers on the board.

2. The students complete the Skullduggery and discuss their answers. The teacher writes the rhyme on the board. The students fill in the answers.

3. The teacher reads "What's Next" to the students. The class discusses the next and last chapter.

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Level 7 Unit 3 Ecological Systems

Chapter 16 People and Ecosystems

Getting Fuel Can Produce Pollution

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
-	16.0	Introduction	45 min.
T-127	16.1	Fossil Fuels Are Limited	100 min. (2 days)
T-128 T	16.8	People Produce Trash That Pollutes (set up experiment)	50 min.
T-127	16.2	Getting Fossil Fuels Pollutes	150 min. (3 days)
T-127	16.3	Water Power Is Clean But Can Cause Damage	150 min. (3 days)

SECTION: 16.0 Getting Fuel Can Produce Pollution
Does not appear in text Introduction (45 min.)

Language Cards/Key Signs
pollution

ADVANCE PREPARATION: Materials - Collect picture of pollution (air, water, etc.). Set up a bulletin board on pollution. Also set up another area with information on oil, gas, coal, conservation, and alternative energy sources. These displays will stay up for the entire chapter.

TEACHING SUGGESTIONS:

1. The students should look at the displays on pollution.

2. The class discusses the concept of pollution, and how it is caused. (NOTE: The students need not read the introduction or look at the picture.)

3. The teacher explains that this final chapter is on people and how they effect the ecosystem.

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SECTION: 16.1 Getting Fuel Can Produce Pollution
Page T-127/S-476 Fossil Fuels Are Limited (100 min. - 2 days)

Language Cards/Key Signs
fossil fuels

ADVANCE PREPARATION: Materials - Complete display on oil, coal and gas. Locate filmstrips or movies on the subject.
*See Teacher's Manual for addresses to get information on coal, oil and gas.

TEACHING SUGGESTIONS:

Day 1

1. The teacher shows the students the collected information about coal, oil and gas.

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2. The class discusses how these things were produced, how they are obtained and refined, and where they are used.

3. If possible, show a filmstrip or movie about one of the resources.

4. At the end of the class, the teacher asks the students to explain formation of the resources and how they are obtained and used.

Day 2

1. The teacher and students read the section.

2. As the students read, they should refer to Figure 16-1 to discuss the amounts of energy available. Included in the discussion could be information about Arab oil, and why the U.S. wants to become energy independent.

3. At the end of the class, the teacher asks the students if there is a limit to fossil fuels. The students could then begin discussing what types of "fuel" will be used when fossil fuels are gone.

* * *

SECTION: 16.8 Getting Fuel Can Produce Pollution
Page T-128/S-488 People Produce Trash That Pollutes (set up experiment)
(50 min.)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for experiment. Write the directions on a chart/transparency. Choose the items to be used yourself.

Identification Cards
(Labels for materials in experiment)

TEACHING SUGGESTIONS:

NOTE: During this lesson, the experiment will be set up. It will be left for the specified two weeks. The results will be observed during lesson 16.8, as it appears in the text.

1. The teacher displays the materials and directions.

2. The students read the directions and label the materials.

3. The teacher passes out the materials to each student.

4. The students complete the set up of the experiment.

5. The class discusses what they think will happen to each particular item. The teacher writes the predictions on a chart.

6. The chart is mounted on a wall behind a table where the trays are put.

* * *

SECTION: 16.2 Getting Fuel Can Produce Pollution

Page T-127/S-477 Getting Fossil Fuels Pollutes (150 min. - 3 days)

ADVANCE PREPARATION: Materials - Collect information about oil spills (National Wildlife) and the effect of oil spills on land and wildlife.

Language Cards/Key Signs
- strip mining
- acid water
- pollution
- a supertanker
- an oil spill

TEACHING SUGGESTIONS:

Day 1

1. (NOTE: On the first day, students should be exposed to the results of obtaining fossil fuels - oil spills, strip mining, using collected pictures or those in the book.)
2. While looking at pictures of oil spills, etc., the students should discuss the possible reasons for the pollution.
3. The teacher writes these reasons on the board/transparency, to be saved for the next two days of classes.

Day 2 and Day 3

1. The teacher and students read the section.
2. The class discusses the reasons for the pollution and checks the actual reasons with their hypothesis on Day 1.
3. The class discusses the problems which these things have created, possible ways to alleviate the problems, and new techniques in clean-up procedures.

* * *

SECTION: 16.3 Getting Fuel Can Produce Pollution

Page T-127/S-480 Water Power Is Clean But Can Cause Damage
(150 min. - 3 days)

ADVANCE PREPARATION: Materials - Make a cut-out of Figure 16-5 with each piece separate, large enough to put on board and be seen by class. Include the water in the cut-outs.

Language Cards/Key Signs
- a dam
- a generator
- hydroelectric power

TEACHING SUGGESTIONS:

Day 1

1. Using the cut-outs, the teacher (with input from students) explains the need and function of a hydroelectric power plant.
2. The teacher should use the following sequence when putting up the cut-outs:
   - first show the river and bedrock. The teacher says that people in this area need electrical power. What should they do?
   - put up dam structure (without power plant, generator or any other structures). Ask students what will happen to river.
   - the teacher adds the cut-outs, piece by piece, upon suggestion of students or teacher explanation.

3. When the entire dam is constructed, the teacher asks several students to explain why it is there and how it produces electricity.

Day 2

1. The students and teacher read the section.

2. During the reading, the students list of pros and cons for using water power is put on board. Use the titles: Water Power Is Good Because and Water Power Is Not Good Because.

3. At the end of the class, verbally (without using cut-outs) discuss how the power plant produces electricity.

Day 3

1. The students read the Highlights. The teacher asks the students questions about the concepts in this section.

2. The students answer the Checkpoints (omit #1).

3. When the students have completed their answers, they should discuss them with the class.

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Level 7 Unit 3 Ecological Systems

Chapter 16 People and Ecosystems

Producing Energy Can Pollute

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-127	16.4	Gases Pollute	100 min. (2 days)
T-128	16.5	Particles Pollute	100 min. (2 days)
T-128	16.6	Air Pollutants Are a Health Hazard	50 min.
T-128	16.7	Nuclear Waste Pollutes	50 min.
T-128	16.8	People Produce Trash That Pollutes	100 min. (2 days)
T-130	-	Rachel Carson and the Environment	50 min.
		Highlights and Checkpoints	50 min.

NOTE: National Wildlife, February, March 1981 has information about pollutants and what is being done about them.

SECTION: 16.4 Producing Energy Can Pollute
Page T-127/S-482 Gases Pollute (100 min. - 2 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for experiment. Write the directions (including warnings) on a chart/transparency.

Language Cards/Key Signs
sulfur dioxide
a smelter
acid rain
acid snow
smog
ozone

Identification Cards
(Labels for materials in experiment)

TEACHING SUGGESTIONS:

Day 1

1. The teacher displays the materials and directions for the experiment (without reading in book).
2. The studehts read the directions and label the materials.
3. The teacher passes out the materials to pairs of students.
4. The students set up the experiment as specified in the directions.
5. Each pair of students should have paper next to their experiment, on which they will record their observations.
6. The students should begin recording at the end of this school day. They should also observe the plants the next morning, at the beginning of school, and then again during science class. They should make their observations for two days.

Day 2

1. The teacher and students first observe the plants and discuss their observations. The students should give possible reasons for the differences in the plants.

2. The class then reads the section. The teacher should make sure that the students relate their experiment to the information in the section.

3. After reading the section, the students should again look at the pictures of air pollution in the display. The class can discuss the cause of this pollution, using the new vocabulary from this section.

4. At the end of the class, the students should again observe the plants and describe the "polluted" situation using the new vocabulary.

* * *

SECTION: 16.5 Producing Energy Can Pollute
Page T-128/S-485 Particles Pollute (100 min. - 2 days)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions. Write the directions on a chart/transparency.

Language Cards/Key Signs
particles
soot
ash
dust

Identification Cards
(Labels for materials in experiment)

TEACHING SUGGESTIONS:

Day 1

1. Before starting the lesson, the students should again observe the plant experiment, discuss their observations and record them.

2. The teacher displays the materials and directions.

3. The students read the directions and label the materials.

4. Working in pairs, the students do the experiment.

5. After they have completed the experiment, they should discuss what they think they will find the next day.

Day 2

1. First the students complete the experiment by drawing the grids on the cover slips, and then looking at the slides.

2. The students discuss the results from the experiment, comparing the slides placed in different locations. At this point, the teacher can write the word particles on the board, and discuss what particles are.

3. The teacher and students read the section. While reading the information, the teacher helps the students relate the information to their experiment.

* * *

SECTION: 16.6 Producing Energy Can Pollute
Page T-128/S-487 Air Pollutants Are a Health Hazard (50 min.)

ADVANCE PREPARATION: Materials - Additional materials on health problems/pollution can be obtained from the Lung Association. Have a picture/transparency of the respiratory system.

Language Cards/Key Signs
emphysema
lung cancer
bronchitis
irritated
respiratory disease

TEACHING SUGGESTIONS:

1. The teacher and students read the section.

2. Using the information from the Lung Association and the picture of the respiratory system, the teacher explains in detail lung cancer, emphysema, and bronchitis.

3. At the end of the class, the teacher asks the students to explain each of the new terms from this section.

****

SECTION: 16.7 Producing Energy Can Pollute
Page T-128/S-488 Nuclear Waste Pollutes (50 min.)

ADVANCE PREPARATION: Materials - Make a chart/transparency of Figure 16-14 without labels. If possible collect information about Three Mile Island and make a small display with the information.
*See Teacher's Manual for information on nuclear power.

Language Cards/Key Signs
nuclear energy
radioactive uranium
radioactive waste

Identification Cards
(Labels for nuclear power system)

TEACHING SUGGESTIONS:

1. The teacher puts the chart/transparency on the board.

2. The teacher explains the nuclear power system to the students, adding labels as the particular section is discussed.

3. After the teacher has completed the explanation, several students can be asked to explain the system to the class.

4. The teacher reads/explains the section to the students, including definitions of new vocabulary.

5. The teacher shows the students the information about Three Mile Island. Using the picture of the nuclear power plant, the teacher shows the students exactly where the problem occured.

6. At the end of the class, the teacher asks the students to explain why radioactive waste is so dangerous to people.

****

SECTION: 16.8 Producing Energy Can Pollute
Page T-128/S-488 People Produce Trash That Pollutes (100 min. - 2 days)

ADVANCE PREPARATION: Materials - Find an area which needs to be cleaned up. Make arrangements to take the students to the place and clean the area. The students should also begin a project at home which can be continued until the chapter is completed. (See optional activity in Teacher's Manual.)

Language Cards/Key Signs
- trash
- litter
- littering
- to decay
- biodegradable
- non-biodegradable

TEACHING SUGGESTIONS:

Day 1

1. Each student takes his/her experimental tray and uncovers the six substances.
2. The class discusses the results of the experiment, and possible reasons for them. The class should compare the prediction chart to the actual observation.
3. The teacher and students read the section, discussing the information and how it relates to the experiment.
4. The teacher writes the words BIODEGRADABLE and NON-BIODEGRADABLE on the board. After reading that paragraph in the text (last one in section) the students identify the biodegradable and non-biodegradable materials in the experiment. The teacher lists these on the board.
5. The teacher asks the students to name other materials for each category. If correctly placed, the teacher writes the name of the material on the board.

Day 2

1. The students and teacher go on their clean-up project, to rid an area of non-biodegradable trash.
2. As the students are working, the teacher can ask them to identify biodegradable and non-biodegradable objects.

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SECTION: - Producing Energy Can Pollute
Page T-130/S-492 Rachel Carson and the Environment (50 min.)
Highlights and Checkpoints (50 min.)

ADVANCE PREPARATION: Materials - Have a copy of Silent Spring and any of Carson's other books on display. NOTE: The text of this section has been omitted.

Language Cards/Key Signs
- a biologist
- to damage
- to destroy
- pesticides

TEACHING SUGGESTIONS:

Day 1

1. The teacher reads the article to the students.
2. The class discusses the dangers of pesticides.

1113

3. The teacher can refer back to the introduction to Chapter 13, which also explains the effects of pesticides on populations.

4. The teacher asks the students to explain why pesticides are dangerous to the environment.

Day 2

1. The students read the Highlights (omit the last one). The teacher asks the students questions about these concepts.

2. For the Checkpoints, give the test as specified below.

   1.

Pollutants	Where it comes from?	Who it affects?	How?
oil spills			
sulphur dioxide			
particles			
radioactive waste			
pesticides			

   2.

BIODEGRADABLE	NON-BIODEGRADABLE

   3. A biodegradable material ____________ (will, will not) decay.
      A non-biodegradable material ____________ (will, will not) decay.

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3. After completing the Checkpoints, the students should discuss their answers with the class.

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Level 7 Unit 3 Ecological Systems

Chapter 16 People and Ecosystems

Preserving Our Ecosystems

SECTION OUTLINE:

Page	Section Number	Lesson Title	Teaching Time
T-130	16.10	Conserving Energy Reduces Pollution	100 min. (2 days)
T-130	16.11	There are Alternative Energy Sources	100 min. (2 days)
T-130	16.12	Recycling Reduces Pollution	100 min. (2 days)
T-131	16.13	Protecting the Victims of Pollution	50 min.
T-131	16.14	Saving Land is Saving Life	100 min. (2 days)
T-131	16.15	We Can Preserve Our Ecosystem	100 min. (2 days)

SECTION: 16.10 Preserving Our Ecosystems
Page T-130/S-493 Conserving Energy Reduces Pollution (100 min. - 2 days)

ADVANCE PREPARATION: Materials - Collect information about conserving energy. Possible sources: Government Printing Office, local power company and water company. Make a display of this material titled "Conservation."

Language Cards/Key Signs
to conserve
conservation
energy

TEACHING SUGGESTIONS:

Day 1

1. The teacher asks the students to first identify forms of energy.

2. Then the teacher asks them to identify types of energy they use, and the mechanism in which it is used, e.g. electricity/hair dryer.

3. The teacher writes the information on the board under the headings:
   Type of Energy Mechanism Used

4. The class then read the section, discussing the meaning of conservation.

5. The students go back to their listing and discuss how the use of these energy sources could be reduced.

Day 2

1. Using the collected materials about conservation, the class discusses conservation in more specific terms.

2. The students should discuss specific things which they and their families can do to conserve energy. (Example: conserving electricity - reduce number of lights on in house, reduce number of times refrigerator is opened, use fewer electrical appliances, etc..) The students should discuss the areas of transportation, heating/cooling, as well as other areas of concern.

* * *

SECTION: 16.11 Preserving Our Ecosystems
Page T-130/S-493 There Are Alternative Energy Sources (100 min. - 2 days)

Language Cards/Key Signs
alternative
a solar cell
a solar collecting panel
geothermal energy

ADVANCE PREPARATION: Materials - By using the drawing in Figure 16-17, or actual pictures, make a bulletin board titled ALTERNATIVE ENERGY SOURCES. Collect additional information about them (Mother Earth News is an excellent source). If possible, find a solar home in your area and ask if you can visit and see the system. Buy a solar cell and connect it to a toy motor or light bulb.

TEACHING SUGGESTIONS:

Day 1
(Either take a trip to visit a solar home or discuss the bulletin board display plus additional materials.)

Day 2

1. The teacher and students read the section.
2. As the class reads about a particular energy source, they should refer to the bulletin board.
3. After completing the section, the teacher asks the students to explain each energy source, and how it works.

****

SECTION: 16.12 Preserving Our Ecosystems
Page T-130/S-496 Recycling Reduces Pollution (100 min. - 2 days)

Language Cards/Key Signs
composting
compost
to recycle
non-biodegradable

Identification Cards
(Labels for materials in experiment)

ADVANCE PREPARATION: Materials - See Teacher's Manual for materials/directions for the experiment. Write directions on a chart. (If the students have a garden plot, or grow plants, they could set up a 'permanent' compost area instead of doing the experiment.) As an outside project, the students could set up a recycling center in the school.

TEACHING SUGGESTIONS:

Day 1

1. The teacher displays the materials and directions.
2. The students read the directions and label the materials.
3. The teacher passes out the materials to pairs of students.
4. The students set up the materials, and then check what is happening and turn the soil as often as is necessary.

Day 2

1. The teacher and students read the section.

2. The class should discuss setting up a recycling center, and what would be necessary.

3. The class should discuss the importance of recycling, and the problem of non-biodegradable trash.

*Check your area for recycling centers and check to see if any local trash collectors pick up leaves and make compost with them. These would be places for the class to visit.

* * *

SECTION: 16.13 Preserving Our Ecosystems
Page T-131/S-499 Protecting the Victims of Pollution (50 min.)

ADVANCE PREPARATION: Materials - National Wildlife Federation has information on endangered species.

Language Cards/Key Signs
endangered species
poaching
extinction

TEACHING SUGGESTIONS:

1. The students first look at Figure 16-23.

2. The class discusses the concept of extinction. Students can list reasons why these organisms are becoming extinct.

3. The teacher and students read the section.

4. The students add to their list of reasons why organisms may become extinct from the information in this section.

5. The class then discusses any additional materials about endangered species which have been collected.

* * *

SECTION: 16.14 Preserving Our Ecosystems
Page T-131/S-511 Saving Land is Saving Life (100 min. - 2 days)

ADVANCE PREPARATION: Materials - Make a chart with directions for the experiment. Find areas around the school where erosion is evident. (NOTE: The experiment in this section has been modified. See below for explanation/materials.)

Language Cards/Key Signs
erosion

TEACHING SUGGESTIONS:

Day 1

1. The students go outside and look at erosion around the school. The teacher asks the students why this has happened (what caused it?).

2. The students return to the classroom. The teacher shows the students the materials and directions for the experiment.

3. The students read the directions. One pair of students can set up each box.

4. The materials are left for the next day's class.

Day 2

1. The students take the materials and complete the experiment, observing carefully as the water is poured.

2. The students discuss the results and why they occured.

3. The teacher and students read the section, relating the vocabulary and information to the experiment.

EXPERIMENT:

-3 cardboard boxes about 12" x 18" x 5"
-dirt for each box to depth of 3 inches
-leaves
-sticks
-grass (a section as large as the box)
-3 bricks
-3 water cans
-water

1. The students set up the three boxes. The first box has only dirt. The second box has dirt, then sticks are stuck into the dirt and leaves are placed on top of the dirt. The third box has the grass plot.

2. Set each box at an angle, propped up on a brick, standing the long way.

3. Fill each watering can with water.

4. One student stands behind each box, holding a can of water.

5. The students pour the water onto the boxes, one at a time.

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4. The teacher asks the students to explain why the erosion occured in those places observed outside the school building.

****

SECTION: 16.15 Preserving Our Ecosystems
Page T-131/S-502 We Can Preserve Our Ecosystem (100 min. - 2 days)

ADVANCE PREPARATION: Materials - Write the poem (page 503) on a transparency.

TEACHING SUGGESTIONS:

Day 1

1. The teacher first puts the transparency on the board. The students read the poem aloud and discuss what it means.

2. The teacher and students read the section and discuss the importance of caring for our ecosystem.

Day 2

1. The students read the Highlights. The teacher asks the students questions about the concepts in this section.
2. The students answer the Checkpoints.
3. After the students have completed their answers, they should discuss them with the class.

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* * *

LEVEL 7

SIGNED VOCABULARY AND LANGUAGE INDEX
FOR
SCIENCE FOR THE HEARING IMPAIRED

Instructions for use of this index with the accompanying signed videotapes are found in the Introduction to the Program. This index should be used as a script when viewing the signed videotapes for the specific SFHI cluster or section of interest.

Each part of the videotape is preceded by an indication of the specific location (level, unit, part, Cluster and Lesson) of the item presented. Each item within a lesson is first presented in American Sign Language (ASL) followed by a Manually Coded English (MCE/SEE) presentation of the same item. When a lesson list is completed the title of the next lesson is given, followed by a presentation of each new lesson item in ASL and MCE.

Teachers should view the videotape in planning for each new cluster (2-5 minutes per cluster). It is also suggested that teachers view and practice the signs presented with their classes following lesson experiences or as a review. The videotape can be used as a visual dictionary when the children have forgotten the sign.

The Signed Vocabulary and Language Videotapes are available for purchase and/or copying by writing

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SCIENCE FOR THE HEARING IMPAIRED

Signed Vocabulary for Level 7

Lesson Title and Key Signs

Chapter 1 Thinking About the World

Introduction
an optical illusion
a magician
a pattern
to trust
to gaze

1.1 What is Observation?
the five senses
to observe
an observation
to notice
to witness
a sense

1.2 Your Eyes Can Feel You
to measure
to focus
to overlap

1.3 Experience Influences What You See
to recognize a pattern
shapes
past experience

1.4 Your Memory Stores Information
to remember
memory
long term memory
information

1.5 You Make Inferences Based on Your Experience
to infer
an inference
experience

1.6 Science Starts With Observation
a scientist
to test inferences
problem solving
to record
tools
a logical way

Lesson Title and Key Signs

1.7 Forming a Hypothesis is Next
a hypothesis
a prediction
an experiment
an observation

1.8 Hypotheses Can Be Tested by Controlled Experiments
the control group
the experimental group
to predict

Chapter 2 Recognizing Life

Recognizing Life
Jupiter
Venus
Mars
a planet
atmosphere
a gas to exist

2.1 What is Life?
a cell
an organism
movement
growth
reaction
reproduction
life activities
energy
environment
a structure

2.2 Respiration Releases Energy From Food
bacteria
yeast
respiration
oxygen
carbon dioxide
to combine
to release
fermentation
gasohol
lime water
a beaker
an aquarium air pump
a rubber tube

Lesson Title and Key Signs

Chapter 2 (cont)

2.3 Some Organisms Make Their Own Food
cholophyll
photosynthesis
sugar
to produce
respiration
a molecule
Elodea
a test tube
a test-tube rack
a wood splint
a rubber stopper
a beaker
masking tape

2.4 Organisms Exchange Gases With Each Other

2.5 The Viking Search for Life
a spacecraft
Viking
Mars
the horizon
soil
a molecule
an automatic device

2.7 You Can Look at Cells
a cell
a slide
a coverslip
a microscope

2.6 Cells Have Many Structures
a structure
function
specialized
cell membrane
cytoplasm
mitochondria
nucleus
nuclear membrane
chromosomes
a vacuole
a cell wall
cellulose
chloroplasts
a paramecium
cilia

Lesson Title and Key Signs

2.8 Organisms Have Different Levels of Organization
a tissue
an organ
an organ system
an organism

Chapter 3 The Many Forms of Life

3.1 Grouping is Organizing
to classify
an organism
similarity
a group

3.2 Group Things by Similarity

3.3 Why Classify Living Things?
a beetle
wild mushrooms

3.4 You Can Classify Organisms
kingdom
phylum
class
order
family
genus
species

3.5 A Species is One of a Kind

3.6 Scientific Names are Useful
Latin
a scientific name

3.7 Some Plants and Animals Don't Fit

3.8 The Moneran Kingdom
monearans
bacteria
blue-green algae
pneumonia
tuberculosis
tetanus
gangrene

3.9 The Protist Kingdom
protists
moist
a flagellum
cilia

Lesson   Title and Key Signs

Chapter 3 (cont)

3.9 (cont)
- a paramecium
- an amoeba
- one-celled algae

3.10 The Fungi Kingdom
- fungi
- a mushroom
- to decay
- mold
- yeast
- reproduction
- gasohol
- antibiotics
- ringworm
- athlete's foot

3.11 The Plant Kingdom
- many-celled algae
- seaweed
- moss
- ferns
- gymnosperms
- angiosperms

3.12 The Animal Kingdom
- sponges
- coelenterates
- flatworms
- roundworms
- segmented worms
- parasites
- hosts
- molluscs
- larva
- echinoderms
- arthropods
- chordates
- vertebrae
- cartilage
- vertebrates
- invertebrates
- amphibians
- reptiles
- cold-blooded
- warm-blooded
- mammals

Lesson   Title and Key Signs

3.13 What are Viruses?
- a virus
- a cell
- to damage
- influenza
- mumps
- polio
- a molecule
- respiration

Working With Animals and Plants
- a career
- a trained assistant
- a veterinarian
- biology
- zoology
- a nursery

Chapter 4 Support Systems

4.2 You Can Observe Amoeba and Paramecium
- an amoeba
- a paramecium
- low magnification
- high magnification
- field of view

4.1 Protists Move in Different Ways
- protists
- cytoplasm
- cilia
- flagellum

4.3 Movement Varies in Soft Bodied Animals
- jellyfish
- squid
- tentacles
- a muscle
- cartilege
- a clam
- an earthworm
- bristles

4.4 Skeltons Support and Allow Different Movement
- a skeleton
- framework
- internal
- the skeletal system
- weightless

Lesson Title and Key Signs

Chapter 4 (cont)

4.5 Arthropods Have Outside Skeletons
an exoskeleton
joint

4.6 Vertibrates Have Internal Skeletons
a vertebrate
an internal skeleton
cartilage
the vertebral column
skull
breastbone

4.7 Joints Allow Movement of Skeletons
a joint
a hinge joint
a ball-and-socket joint
a gliding joint
a disc
a fixed joint
a ligament

4.8 Internal Skeletons Grow
a tissue
a bone cell
calcium
a blood vessel
bone marrow
molting

4.9 How Big Can an Animal Be?

4.10 Muscles Move the Skeleton
a muscle
a muscular system
to contract
a tendon
a ligament
a biceps
muscle
a triceps
to relax

4.11 Muscles Have Special Functions
voluntary muscles
a striated muscle
involuntary muscles
smooth muscle
cardiac muscle

Lesson Title and Key Signs

Repairing Sports Injuries
an injury
a physical therapist
a researcher
surgery
certification

4.12 Water Organisms Stay Near the Surface
photosynthesis
shallow water
a holdfast
an air bag

4.13 Land Plants Have Support Structures
non woody plants
to wilt
plants
bark
cambium
xylem
cellulose
lignin

Chapter 5 Digestion and Excretion

5.1 Why Do Organisms Need Food?
energy
reproduction
a cell
digestion
excretion

5.2 Many Substances Are Found in Food
nutrients
proteins
fats
carbohydrates
starch
sugars

5.3 How Does Food Get Into Cells?
a molecule
a cell membrane
diffusion
a space

5.4 Enzymes do the Work
saliva
soda crackers
an enzyme
digestive enzymes

Lesson Title and Key Signs

Chapter 5 (cont)

5.4 (cont)
gelatin
a petri dish

5.5 The Energy in Food Can be Measured
a calorie
weight
weight gain
weight loss

5.6 A Balanced Diet is Important
vitamins
minerals
protein
carbohydrates
fats
a disease
a balanced diet

5.7 Digestion in a Small Animal
digestion
a hydra
an amoeba
to paralyze
tentacles

5.8 Large Organisms Have Digestive Systems
the digestive system
salivary glands
esophagus
the stomach
the intestines
the pylorus
the pancreas
the liver bile
the gall baldder
villi
the appendix
the rectum
the anus

5.9 Plants Also Digest Food
photosynthesis
starch

Lesson Title and Key Signs

5.10 Digestive Systems Vary
a gizzard
cellulose
bacteria
termites
fungus

5.11 Kidneys Get Rid of Urea
a kidney
urea
to excrete
the excretory system
urine
uretha
the bladder

5.12 Kidneys Help Control Water Loss Also
to sweat

5.13 Excretory Systems Vary
uric acid
a donor
the artificial kidney
a transplant

Chapter 6 Respiratory Systems

Introduction
the underwater world
a diver
an air tank

6.1 Oxygen Goes In; Carbon Dioxide Comes Out
gas exchange
oxygen
carbon dioxide
an astronaut

6.2 Gases Are Exchanged With Water and Air
to dissolve
a molecule
diffusion
an earthworm

6.3 Special Structures Exchange Gases
gills
respiratory system

Lesson Title and Key Signs

Chapter 6 (cont)

6.4 Many Land Animals Breath
the trachea
to breathe
an air sac
the lungs
an insect
an amphibian

6.5 Air Moves Into and Out of the Lungs
the epiglottis
the trachea
the larynx
the vocal cords
bronchi
bronchioles
air sacs
the diaphram

6.6 Breathing is Automatic
automatic
to faint

6.7 Your Respiratory System Does More Than Breath
mucus
to cough
an aqualung
a skin diver
research
resources

6.8 Plants Have Structures for Gas Exchange
respiration
photosynthesis
the epidermis
a stomate
chloroplasts
tightly packed cells
loosely packed cells
upper
lower
guard cells

Chapter 7 The Importance of Transport

Lesson Title and Key Signs

7.1 What is a Circulatory System?
oxygen
waste
blood
heart

7.6 The Heartbeat Rate Changes Automatically
pulse
wrist
exercise
heartbeat
rate

7.5 The Heart Pumps the Blood
chambers
atrium
ventricle
to contract
to relax
a valve

7.4 You Have Two Circulation Pathways
blood vessels
vena cava
pulmonary artery
vein
aorta

7.7 Blood Moves Through the Blood Vessels
an artery
a vein
a capillary
a valve

7.8 Blood is About Half Plasma
a blood bank
a transfusion
plasma
a blood clot

7.9 The Plasma Carries Blood Cells
red blood cells
hemoglobin
a capillary
bone marrow

Lesson	Title and Key Signs
Chapter 7 (cont)	
7.9 (cont)	white blood cells bacterium cell antibodies platelets
7.11	People Have Different Blood Types blood types a blood transfusion blood protein
7.10	The Lymphatic System is Another Transport System tissue fluid lymph ducts lymph nodes infection the lymphatic system
7.13	Water Moves Up in Plants
7.12	Plants Have Transport Systems xylum cambium root hairs
7.14	Food Moves Up and Down in Plants phloem to reproduce sap
Chapter 8	Internal Communication Systems
8.1	Neurons Send Signals a stimulus a reaction the senses nerve cells neurons a cell body dendrites axon impulse synapse nucleus cytoplasm
8.3	Many Neurons Make a Nervous System a nervous system nerves a brain a spinal cord vertebrae
8.2	Behavior is Caused by Neurons behavior sensory neurons association neurons motor neurons stimulus response
8.4	The Human Nervous System the central nervous system the peripheral nervous system the cerebrum the cerebellum the medulla
8.5	The Sense of Sight sight the cornea the iris the pupil the lens the retina rod cells cone cells the optic nerve blindness
	Aids for the Blind a device Braille a camera electrical signals an image a calculator a computer a handicap
8.6	The Sense of Hearing the outer ear the middle ear the inner ear the eardrum the hammer

Lesson **Title and Key Signs**

Chapter 8 (cont)

8.6 (cont)

the stirrup
the semicircular canals
the ear canal
the anvil
the auditory nerve
the oval window
the cochlea
the eustachian
an otoscope
an audiogram

8.7 The Senses of Smell and Taste
smell
taste
taste buds
nostril
sensory neurons

8.8 The Skin and Body Have Many Senses
touch
balance
body sense
circular canals
the cerebellum
body sense

8.9 There Are Differences Among Animal Senses
a trained dog
an echo
high pitched sounds
dynamite
a magnetic field

8.10 Some Behaviors Are Reflexes
reflex
an automatic response
coughing
sneezing

8.11 Many Behaviors Are Combinations of Responses
instinct
migration
learning
memory

Lesson **Title and Key Signs**

8.11 (cont)
reasoning
trial-and-error learning

8.12 The Endocrine Glands Produce Hormones
the endocrine system
hormones
chemicals
the pituitary glands

8.13 Hormones and Nerves Work Together
the brain
nerves
a reaction
the adrenal glands
adrenalin

8.14 Plants Have Hormones
auxins
tropism

Chapter 9 Reproduction

Introduction

Reproduction

9.5 Fungi Reproduce With Spores

9.1 Life Comes From Life
Aristotle
Jan van Helmont
spontaneous generation
Francesco Redi

9.2 Cell Divides In Two
chromosomes
cell division
mitosis
replication
interphase
prophase
spinale fibers
metaphase
equators
anaphase
telephase

Chapter 9 (cont)

Lesson	Title and Key Signs
9.3	Some Organisms Reproduce by Budding budding a hydra a bud yeast
9.4	Regeneration is a Form of Reproduction planaria a flatworm regeneration
9.5	Fungi Reproduce With Spores bread mold hyphae a spore mushrooms
9.6	Many Organisms Have Sexual Reproduction sexual reproduction sex cells gametes fertilization zygote asexual reproduction off-spring
9.7	Ferns Reproduce With Spores and Gametes sori a fern gametes eggs sperm two-stage reproduction
9.8	Pines Reproduce With Cones the reproductive organs pollen grains a sperm-producing cone an egg-producing cone pollination embryo a seed
9.9	Some Plants Reproduce With Flowers a flower sepals petals stamens anther the pistil the stigma the style the ovary ovules pollen grain
9.10	Animal Reproduction Involves Many Behaviors vertebrates invertebrates territory courtship nesting mating societies spruce trees the spruce budworm a chemical pesticide pheromone a trap
9.11	How People Become People pregnant gestation an embryo the uterus the amnion the umbilical cord a fetus
9.12	Birth Occurs at the End of Gestation contractions labor navel belly button after birth

Lesson	Title and Key Signs
Chapter 10 - Inheritance	
10.0	Introduction genetics breeding
10.1	The Chromosome Number is Reduced in Gametes inherited characteristics genes a zygote chromosomes meiosis
10.2	The Male Determines the Sex of Offspring the sex chromosomes meiosis
10.3	Some Genes Are Dominant or Recessive dominant recessive a first generation cross a second generation cross a taster a non-taster a pure trait a hybrid trait
10.4	Most Traits Are Caused by Many Genes dominant genes recessive genes variation physical traits
10.5	Some Traits Go With Sex color blind a carrier a sex-linked trait hemophilia
10.6	Some Diseases Are Inherited sickle cell anemia
10.7	Births Can Be Multiple a multiple birth twins triplets quadruplets quintuplets sextuplets fraternal twins identical twins Siamese twins

Lesson	Title and Key Signs
10.8	More Useful Organisms Can Be Developed an ancestor teosinite tassels kernels ears of corn breeding desirable inherited traits selection hybrid crossing
10.9	Environment Influences Inherited Traits environment an ability a talent genetics a bloodhound a pointer
Unit 3	Chapter 11 - Communities
11.1	What Is A Pond? a reservoir a lake a stream
11.2	A Pond Contains Many Organisms a pond an organism
11.3	Energy Links Organisms a food chain energy a producer a consumer a first-order consumer a second-order consumer a decomposer a scavenger a predator the prey
11.4	A Pyramid of Food a food pyramid algae rotifers minnows pickerel
11.5	Food Chains Form Food Webs a Food Web eating interactions

Lesson	Title and Key Signs
Chapter 11	(continued)
11.6	Ponds Connect to Other Environments
11.7	Each Organism Has a Place in a Community to help/to harm a community a habitat a niche a chimpanzee a gorilla
11.8	Pond Communities Change Through Succession succession a glacier a pit concentration
11.9	Succession Eventually Ends a pioneer community a climax community the climate

Unit 3 - Chapter 12 World Ecosystems

Lesson	Title and Key Signs
12.1	Matter is Recycled to recycle matter hydrogen oxygen the water cycle evaporation condensation precipitation
12.2	The Carbon and Oxygen Cycles producers consumers scavengers decomposers carbon dioxide respiration the carbon cycle the oxygen cycle to exchange
12.3	The Nitrogen Cycle nitrogen proteins bacteria the nitrogen cycle
12.4	Gas Exchange in a Balanced Aquarium an aquarium an air pump gravel a snail
12.5	Organisms are Parts of Ecosystems an ecosystem a community a meadow an orange grove a rice paddy upwelling an estuary ecosystem
12.6	Climate Influences Ecosystems a deciduous forest an evergreen forest the tundra the tropical rain forest the temperate grasslands the African savanna the desert the climate tropical the tropic zone a polar climate the polar zone temperate the temperate zone
12.7	Ecosystems Have Different Soils humus a forestry technician a soil conservationist

Unit 3 - Chapter 13 Populations

Lesson	Title and Key Signs
13.0	Populations Came in Different Sizes an insecticide a population
13.2	How Can A Population Change increasing population decreasing population
13.3	Population Growth Is Limited a limiting factor
13.4	Populations Effect Each Other a wildlife manager

Lesson	Title and Key Signs
13.5	Are Their Limits on Human Population Growth? a census
13.6	What Will Happen to the Human Population?

Unit 3 - Chapter 14 Natural Selection

Lesson	Title and Key Signs
14.1	Organisms Can Live With A Little Change an ecosystem to survive a predator
14.2	Individual Differences Help Species Survive
14.3	Environmental Change adaptation a peppered moth coal natural selection
14.4	New Species Sometimes Appear a species natural selection a natural barrier a mutation
14.5	Organisms Can Become Fossils a fossil preserved a cast a mold petrified
14.6	Ancient Ecosystems Include Dinosaurs a dinosaur
14.7	Dinosaurs Were Losers in the End extinct prehistoric

Unit 3 - Chapter 15 Fitness and Health

Lesson	Title and Key Signs
15.1	Exercise Strengthens Muscles a fit body exercise vertebrae the abdominal area
15.2	Be Good To Your Heart a heart attack hardening of the arteries a blood clot
15.3	Proper Eating Provides Necessary Materials nutrition a balanced diet artificial ingredients
15.4	The Body Needs Sleep
15.5	Skin Is The First Line of Defense a pore a blood vessel sweat acne the epidermis the dermis sensory neuron oil gland sweat gland
15.6	The Mouth Contains More Than You Think dental floss bacteria a cavity a dentist a molar an incisor a premolar a canine plaque tartar a dentist enamel dentine pulp
15.7	There is Life In and On People bacteria protists viruses fungi immunity
15.8	Cuts and Scratches Can Be Dangerous infection inflammation tetanus bacteria

Lesson	Title and Key Signs
15.9	Infectious Disease Can Be Dangerous infectious disease a fever strep throat rheumatic fever venereal disease gonorrhea syphilis
15.10	Some Diseases Can Be Prevented or Cured a vaccine antibiotic penicillin an epidemiologist
15.11	What Is A Drug? a drug side effects
15.12	Common Drugs Can Be Dangerous caffeine a stimulant an alcoholic drunk nicotine cancer alcohol a relaxant
15.13	Getting High Can Leave You Low barbituates amphetamines narcotics marijuana legal/illegal hallucinogens

Unit 3 - Chapter 16 People and Ecosystems

Lesson	Title and Key Signs
16.0	Introduction pollution
16.1	Fossil Fuels are Limited fossil fuels
16.2	Getting Fossil Fuels Pollutes strip mining acid water pollution a supertanker an oil spill
16.3	Water Power Is Clean But Can Cause Damage a dam a generator hydoelectric power
16.4	Gases Pollute sulfur dioxide a smelter acid rain acid snow smog ozone
16.5	Particles Pollute particles soot ash dust
16.6	Air Pollutants Are A Health Hazard emphysema lung cancer bronchitis irritated respiratory disease
16.7	Nuclear Waste Pollutes nuclear energy radio-active uranium radio-active waste
16.8	People Produce Trash That Pollutes trash littering to decay biodegradable non biodegradable
16.9	Rachel Carson and The Environment a biologist to damage to destroy pesticides
16.10	Conserving Energy Reduces Pollution to conserve conservation energy

Lesson	Title and Key Signs	Lesson	Title and Key Signs
16.11	There Are Alternative Energy Sources alternative a solar cell a solar collecting panel geothermal energy		
16.12	Recycling Reduces Pollution composting compost to recycle non bio-degradable		
16.13	Protecting the Victims of Pollution endangered species poaching extinction		
16.14	Saving Land is Saving Life erosion		
16.15	We Can Preserve Our Ecosystem		